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RAUCOURT (M.), TROUVELOT (B.) & BÉGUÉ (H.). **L'essai d'efficacité des produits antidoryphoriques.**—*Ann. Épiphyt. Phytogén.* **5** fasc. 1 pp. 51–83, 10 figs. Paris, 1939.

The introductory notes to this paper, which concern the desirability and possibility of officially testing the effectiveness of insecticidal products in France, have already been noticed [*R.A.E.*, A **27** 675]. The general character of commercial products for the control of *Leptinotarsa decemlineata*, Say, on potato, the various factors affecting the value of an insecticide, and the three methods of testing it biologically, the laboratory, field and trial plot methods, are briefly discussed. An outline is given of the bionomics of *L. decemlineata* in the field, together with notes on the causes of natural mortality and the influence of temperature on insecticidal action, which increases with a rise of temperature whether stomach or contact insecticides are under consideration, and an account of the technique used in rearing larvae for experiment. The official method of testing products for the control of *L. decemlineata*, which is by treating larvae on test plots, is described in great detail, and a method of laboratory testing on individual insects, which is used for theoretical research, is also described. The operation of the testing system in practice is outlined. The tests are carried out at the request and expense of the manufacturers. The results are submitted to a consultative committee, including representatives of the manufacturers, growers and health services, who were nominated on 7th December 1938. The relevant legislation is appended.

VEITCH (R.). **Cotton Growing in Queensland. Pt. II. Cotton Pests.**—*Bull. Dep. Agric. Stk Qd* no. 15 pp. 27–52, 41 figs. Brisbane, 1938. [Recd. 1939.]

This is a reprint of the parts of a work already noticed [*R.A.E.*, A **27** 87] that deal with cotton pests, with the addition of notes on several other pests of minor importance on cotton in Queensland.

KING (C. B. R.). **Tortrix Control.**—*Tea Quart.* **12** pt. 2 pp. 86–91. Talawakelle, 1939.

The regulations in force in Ceylon for the control of the tea tortrix, *Homona coffearia*, Nietn., are given [*R.A.E.*, A **16** 447], and reference is made to a scheme recently devised for their efficient operation [**25** 586]. However, the introduction of a parasite, *Macrocentrus homonae*, Nixon [**27** 19], from Java has modified the situation and may make it possible to abolish compulsory control. Numerous species of parasites were already present in Ceylon, but the combined control effected by them was negligible [**22** 167 ; **24** 136, etc.]. The history of the introduction and establishment of *M. homonae* are reviewed [**26** 337]. In February 1937, it had spread over 50 acres round the point of first liberation, but the second importation had apparently not become established. Details of subsequent liberations are given. At the end of another year and two years, the parasite was established over 1,000 acres and 600 sq. miles, respectively. It has been found on 29 estates in 6 districts and is probably present on very many more. Recorded parasitism usually varies between 50 and 100 per cent., as compared with 5 per cent. by other parasites before its introduction. The process of oviposition is described. The egg is

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laid in the host larva through the rolled leaf in which the latter is lying. The female often misses the objective. Brief notes are given on the subsequent development, about which little is known [*cf.* **26** 337; **27** 20]. The probable future status of host and parasite and the possibility of the development of *M. homonae* being checked by hyperparasites [**26** 639] are discussed.

FRAPPA (C.). **Note sur deux nouvelles chenilles nuisibles à l'arachide à Madagascar.**—*Bull. écon. Madagascar* N.S. no. 17 pp. 51–54, 8 refs. Tananarive, 1939.

Notes are given on the bionomics of the Geometrid, *Boarmia selenaria*, Schiff., and the Noctuid, *Achaea finita*, Gn., the larvae of which sometimes cause serious damage to ground-nuts on the high plateaux in central Madagascar. All stages of *B. selenaria* and the larva, pupa and adult of *A. finita* are described.

In the laboratory, females of *B. selenaria* usually laid their eggs indiscriminately on the leaves of ground-nuts, and the larvae hatched in about 10 days. Unlike those of other species of *Boarmia*, they were very active and voracious; those that appeared on 18th April completed the larval stage in 53 days, but in the hot season development is probably more rapid. Pupation took place in the soil, and the adults emerged in 14–16 days. Oviposition began 2–3 days after pairing. It is considered that there are at least three generations a year on the plateaux. The eggs overwinter from July onward and hatch at the end of September or beginning of October; the adults appear about mid-December, the beginning of April, and mid-July. Larvae that hatch at the end of July do not survive. On the plateaux, the vegetation period of ground-nuts normally extends from the end of November until the beginning of April, and the first-generation larvae, which occur in January–March, cause the greatest damage to the crop. In cases of severe infestation, the leaves are skeletonised and the plants weakened, so that fruits are not developed. The larvae of the overwintered generation probably feed on other wild or cultivated leguminous plants. Preliminary observations on *A. finita* showed that the larvae were particularly abundant in the field at the end of the hot season in February and March. The pupal stage lasted about 15 days.

No parasites of these insects have been observed in Madagascar. Control measures comprise handpicking the larvae if infestation is slight, or, if large areas are involved, spraying with an emulsion of vegetable oil [*cf. R.A.E.*, A **25** 314].

VAYSSIÈRE (P.). **Au sujet de l'organisation de la lutte contre les insectes nuisibles au Sénégal et au Soudan.**—*Act. Ass. Col.-Sci.* **15** no. 166–167 pp. 45–52, 65–70, 6 refs. (In *Rev. Bot. appl.* **19.**) Paris, 1939.

In the first part of this paper, the author deals with details of the local organisation for the supervision and control of the outbreak area of *Locusta migratoria migratorioides*, R. & F., in the river Niger inundation area in the French Sudan, proposed by the French delegation at the Fifth International Locust Conference [*cf. R.A.E.*, A **27** 482]. During his stay in the French Sudan in May 1938, he observed a swarm of *Anacridium moestum melanorhodon*, Wlk., near

Djenné-San and one of *L. m. migratorioides* between San and Koutiala. In March 1938, numbers of *Nomadacris septemfasciata*, Serv., were observed in Ké Macina [*cf.* **27** 570, 571].

In the second part, it is stated that more than 59,000 tons of stored ground-nuts were destroyed by the Bruchid, *Pachymerus cassiae*, Gyll. (*acaciae* auct.) [*cf.* **24** 239; **25** 96] and more than 44,000 tons of grain by weevils and other pests in Senegal in 1937, and it was anticipated that the loss would be equally great in 1938. With reference to the proposed construction of warehouses and silos for the better storage of these crops, the author emphasises the necessity of some sort of protection against infestation by insects and suggests that hermetically sealed compartments would be preferable to the proposed installation for fumigation, as the latter would be useless without a means of circulating the fumigant through the grain. Tests were carried out on the disinfestation and protection of stored wheat by means of amorphous dusts of silica, silica gels and magnesium oxide, which have a dehydrating effect on insects. Weevils were killed in a few days and uninfested wheat was protected from infestation by magnesium oxide at the rate of 1 part per 1,000 by weight, while certain silica gels were equally effective at 1 part per 5,000. It was unnecessary to clean the grain in view of the small quantities of dust applied.

Both in the French Sudan and in Senegal, considerable damage is caused by termites to timber in buildings. It is recommended that suitable precautions should be taken in their construction [*cf.* **17** 543, 730, etc.].

CHORLEY (J. K.). **Report of the Division of Entomology for the Year ending 31st December, 1938.**—*Rhod. agric. J.* **36** no. 8 pp. 598–622; also as *Bull. Minist. Agric.* [S. Rhodesia] no. 1121, 25 pp. Salisbury, 1939.

Southern Rhodesia continued to be infested by *Nomadacris septemfasciata*, Serv., during 1938 [*cf. R.A.E.*, A **27** 124]. Owing to the destruction of hoppers in all accessible areas, there was no serious general damage to crops, but considerable local injury was caused to native crops by flying swarms in the Zambesi valley, where sparse population and inaccessibility made control difficult, and the damage was intensified by drought. There were continual invasions of flying swarms from Portuguese East Africa in the eastern districts, during the winter and summer, and other swarms, probably originating in Rhodesia, invaded the northern Transvaal and Bechuanaland Protectorate during October.

Infestation of tobacco by *Bemisia rhodesiaensis*, Corb., was not serious, but in one district, *Myzus persicae*, Sulz., increased alarmingly in January. This Aphid is believed to have spread from slightly infested seed beds and is of importance as it transmits the virus of tobacco rosette [*cf.* **27** 125, 226]. The ants, *Pheidole liengmei* subsp. *micrartifex*, Forel, and *Tetramorium setuliferum*, Emery, carried off newly sown seed during October and November in some districts. Other pests of tobacco were *Brachytrypes membranaceus*, Dru., which was prevalent in one district in December, *Gnorimoschema* (*Phthorimaea*) *operculella*, Zell., and *G.* (*P.*) *heliopa*, Lw., which caused considerable local damage, *Eulepida mashona*, Arrow, *Trachynotus* sp. and *Psammodes* sp., which attacked the roots of newly transplanted

tobacco, and *Analeurops* sp., which injures the leaves of plants in seed beds. Local outbreaks of *Lasioderma serricorne*, F., occurred in stored tobacco where stocks were kept after the end of the tobacco sales.

Insects injurious to maize in various localities included *Laphygma exempta*, Wlk., which was destroyed on two farms by storks, *Busseola fusca*, Fuller, *Cirphus loreyi*, Dup., *Eulepida mashona*, which attacked the roots of large plants, and *Tanymecus rapax*, Mshl., *T. destructor*, Mshl., *Systates exaptus*, Mshl., and *Epilachna similis*, Thnb., which attacked seedlings. Pests of cotton included *Heliothis armigera*, Hb., infestation by which was less than in many previous years, the Jassid, *Empoasca facialis*, Jac., *Aphis gossypii*, Glov., which was prevalent during the drought in February and March, and *Dysdercus* spp., which caused only slight injury, probably owing to the prohibition of ratooning.

On *Citrus*, infestation by *Argyroploce leucotreta*, Meyr., was heavier than in former years, but that by *H. armigera* was very light, possibly because unusual warmth early in the winter caused some of the overwintering pupae to develop much earlier than usual. *Aphis tavaresi*, Del G., and *Scirtothrips aurantii*, Fauré, were of little importance and were controlled by the usual spray of lime-sulphur and nicotine. *Adoretus tessulatus*, Burm., and *Anomala exitialis*, Pér., damaged the foliage and blossom of apple in October–November, *Ancistrotermes crucifer*, Sjöst., and *Termes pauperans*, Silv., injured the bark and roots of newly planted deciduous fruit trees in July, and larvae of *Parasa latistriga*, Wlk., which were heavily parasitised by *Oneilella* sp. and by *Chrysis* (*Pentachrysis*) *bombycida*, Mocs., defoliated plums in June–July. In Salisbury, a further spread of the white mango scale, *Aulacaspis cinnamoni*, Newst., was recorded.

Large areas of sunn hemp (*Crotalaria juncea*) had to be resown in several districts as a result of mass infestation by *Exora discoidalis*, Jac., in early December. Crops sown in late December were not much injured. Cowpeas and soy beans were defoliated by *Ootheca mutabilis*, Sahlb., and *Dolichos lablab* was heavily infested by *H. armigera*. *Toxoptera graminum*, Rond., caused some damage to barley in June. Pests of vegetables and garden plants included *Eriophyes* sp. on tomato, *Macrosiphum compositae*, Theo., on artichoke [*Cinara*], *M. onobrychis*, Boy. (*pisi*, Kalt.) on sweet pea [*Lathyrus odoratus*], *Brachycerus interstitialis*, Fhs., on the flowers of aloe, *B. congestus*, Gerst., on Liliaceous and Amaryllidaceous plants, and *Margarodes* sp. on the roots of *Clarkia*.

Other insects observed or identified during the year included *Exora kohlschütteri*, Weise, defoliating sunn hemp, *Apion asphaltinum*, Boh., *Bruchus obscurus*, Fhs., *B. albosparsus*, Fhs., and *Aphomia pimelodes*, Meyr., in seed pods of *Indigofera emarginella*, *I. arrecta*, *Acacia* sp. and *Cassia abbreviata*, respectively, and *Catantops melanostictus*, Schaum, which has injured the leaves of tobacco in December.

VAN SCHALKWIJK (H. A. D.). **The Status of *Wohlfahrtia euvittata* Vill. (Diptera, Sarcophagidae) as a Parasite of the Brown Locust.**—*J. ent. Soc. S. Afr.* **2** pp. 18–35, 10 figs., 17 refs. Pretoria, 1939.

The natural habitat of *Wohlfahrtia euvittata*, Villen., in South Africa coincides with that of the brown locust (*Locustana pardalina*, Wlk). The flies deposit larvae on exposed locust eggs, on hoppers

(mainly when moulting or unhealthy) and on adults, as well as on various decaying substances. The larval stage lasts 8–9 days, the pupal 25–30 and the adults larviposit 25 days after emergence. Thus, the total life-cycle occupies about 50–60 days, while the locust completes a generation in 45–50 days. Artificial breeding of the fly on raw beef is possible, but mortality is high and such breeding is not considered practicable for the purpose of locust control in the field. Moreover, there are no records of any large-scale destruction of locust hoppers by *Wohlfahrtia* or of its attacking locusts of the solitary phase, the control of which is of utmost importance.

Detailed descriptions of all stages in the development of the fly are given.

DU PLESSIS (C.) & BOTHA (D. H.). **Preliminary Field Experiments on the Attractiveness of certain Chemicals and Bait Carriers to the Hoppers of the Brown Locust.**—*J. ent. Soc. S. Afr.* **2** pp. 74–92, 3 refs. Pretoria, 1939.

The relative attractiveness of certain chemicals and bait carriers to the brown locust (*Locustana pardalina*, Wlk.) was studied by surrounding a band of gregarious hoppers by a galvanised iron barrier in a circular area 96 feet in circumference and observing the numbers of hoppers visiting trays of the materials tested as well as control trays of sand. The results treated statistically showed that sodium arsenite, barium fluosilicate and sodium fluoride are neither attractive nor palatable to the hoppers, while they are also not strongly repellent. Among the potential taste improvers, molasses proved to be of no value as an attractant, while salt and sodium phosphate showed some attractiveness. The addition of sodium phosphate to horse-dung baits increased their attractiveness. Of the three carriers tested, bran was the most attractive and horse dung more attractive than cattle dung. The addition to the horse-dung bait of oil (Mobiloil AA, 4 gals. per 100 lb. dung) did not improve its attractiveness, and the oil even seemed to act as a repellent.

SARAIVA (A. C.). **A preliminary List of the Insect Pests of Crops and Fruit Trees in Portuguese East Africa.**—*J. ent. Soc. S. Afr.* **2** pp. 101–114. Pretoria, 1939.

A list, arranged in systematic order, is given of 135 species of insect pests of crops and fruit trees in Portuguese East Africa, showing their food-plants and distribution in the Colony and the types of injury they cause. In a second list, the insects are arranged under the principal crops attacked, namely *Citrus*, coconut, cotton, kapok, maize, sugar-cane and tobacco.

COATON (W. G. H.). **Field Tests of Poison Bait against Hoppers of the Red Locust, 1935–36.**—*J. ent. Soc. S. Afr.* **2** pp. 115–133. Pretoria, 1939.

The main conclusions obtained from field experiments conducted in Zululand in 1935–36 on the use of poison baits against the red locust (*Nomadacris septemfasciata*, Serv.) coincide with those reported by Faure and Jacot-Guillarmod as a result of subsequent work [see next paper]. A bait of maize meal containing 1 per cent. sodium arsenite

and 7 per cent. molasses was successfully used in dense, green and succulent vegetation up to five feet in height. It is, however, less attractive to hoppers of the red locust than to other locust species, and is eaten only when they happen to walk over it. It is recommended to use the bait in a wet state, in which it would stick to plants. A dosage of 90–120 lb. (dry weight) per acre was necessary to obtain a satisfactory kill in dense vegetation, and the kill was not increased by raising the dosage to 200 lb., or by raising the molasses content to 14, 21 and 28 per cent.

FAURE (Jacobus C.) & JACOT-GUILLARMOD (C. F.). **Field Experiments on Poison Bait against Hoppers of the Red Locust: 1936–37.**— *Sci. Bull. Dep. Agric. S. Afr.* no. 211, 52 pp., 20 tables, 10 refs. [Pretoria] 1940.

This report covers the results of experiments in Zululand in the season 1936–37 to study the use of poison baits against *Nomadacris septemfasciata*, Serv.

The history of the use of baits against this locust is reviewed, including a record of attempts to employ them against adult swarms, which proved unsuccessful owing to the unpredictable behaviour of the insects and the difficulty of transport to the places where swarms may descend to rest. Baits were adopted as the standard government method of dealing with young hoppers during 1936–37 and were used against all the instars in 1936–37. In 1938–39 they were exclusively used in a severe hopper outbreak in the Transvaal and about 4,000 tons were issued by the government.

The experiments were performed in galvanised iron enclosures 24 feet in circumference or on portions of free bands. In both cases the mortality was determined by means of cage samples, and all results were analysed statistically. The addition of sweetening substances (sugar and molasses) did not result in an increase of mortality. Experiments with carriers showed that wheat bran was better than maize bran, or than a mixture of maize bran and oat bran, which are, however, less expensive. Sawdust alone gave significantly poorer mortalities than maize bran, but mixtures of equal parts of sawdust and wheat bran or maize bran proved to be as effective as maize bran alone. The mortality with maize meal was intermediate between those with maize bran and with sawdust, but did not differ significantly from either. Owing to practical difficulties in dealing with sawdust at the mixing stations (due to the irritating dust given off), its use is not recommended. Field experiments on the rate of application did not show significant differences between dosages of 45, 90 and 135 lb. per acre, but in an enclosure experiment, a dosage of 180 lb. per acre gave better results than one of 60 lb. In field tests, the addition of 2 per cent. turpentine did not affect the results in any way.

Since excellent results were obtained in spite of the very unfavourable conditions under which the experiments were conducted (tall and dense grass, rainy weather and heavy dews), baiting is strongly recommended against this locust. Detailed instructions for the use of the standard bait issued by the South African Government (which consists of maize meal or maize bran mixed with sodium arsenite and colouring matter) including the precautions against poisoning and the use of antidotes, are given.

HARRIS (W. V.). **Annual Report of the Entomologist for the Year 1938.**—*Ent. Leafl. Dep. Agric. Tanganyika* no. 17, 5 pp. Dar es Salaam, 1939.

Cotton pests were, on the whole, not abundant in Tanganyika Territory in 1938. Brief notes are given on the distribution of the pink bollworm [*Platyedra gossypiella*, Saund.] in the Lake Province [*cf. R.A.E.*, A **26** 642]. *Diparopsis castanea*, Hmps., and *Argyroploce leucotreta*, Meyr., were found on cotton in the Songea highlands, and *Dysdercus fasciatus*, Sign., and *D. nigrofasciatus*, Stål, were locally associated with internal boll disease. Infestation by Aphids was general, owing to the sudden termination of the rainy season. A serious outbreak of *Marasmia trapezalis*, Gn., occurred on maize in the Moshi district. Sweet potatoes were attacked by the larvae of the weevil, *Blosyrus scopulifer*, Ancey, which bored in the stems, and by those of *Acraea acerata*, Hew., which defoliated the plants; the latter only appears in numbers at intervals of several years. Other pests recorded include the Bostrychid, *Xylopsocus capucinus*, F., in stored derris root, *Lasioderma serricorne*, F., in stored areca nuts [*Areca catechu*], the weevil, *Sipalus aloysii-sabaudiae*, Camerano, on ceara rubber [*Manihot glaziovi*], and the Lamiids, *Sthenias cylindrator*, F., in oleander (*Nerium oleander*), *Ceroplesis conradti*, Kolbe, which injured saplings of the timber tree, *Chlorophora excelsa*, and *Apomecyna acutipennis*, Kolbe, in stems of the oyster nut (*Telfairia pedata*). *Nomadacris septemfasciata*, Serv., was present in the valley of the Kagera River during the earlier part of the year, and swarms of *Locusta migratoria migratorioides*, R. & F., entered Musoma from the north in October and oviposited, but the resulting hoppers were destroyed.

STOREY (H. H.). **Plant Pathology. Virus Diseases of Plants.**—*Rep. E. Afr. agric. Res. Sta. Amani* **11** 1938 pp. 13–19. London, H.M.S.O., 1939.

During investigations carried out at Amani, Tanganyika, on the transmission of streak virus of maize by *Cicadulina mbila*, Naudé [*cf. R.A.E.*, A **26** 756], evidence was obtained of the presence of the virus in the saliva of the insect. It is considered that the insect emits extremely small quantities of virus, which are, however, above the minimum needed to infect the plant. An infective individual, when subjected to a succession of weekly tests without intermediate access to a source of virus, normally causes infection in every plant until it dies, but many of the leafhoppers soon become non-infective. The duration of the original feeding period on a diseased plant has some effect on the length of time for which infectivity is retained. Seed of certain inbred lines of maize that had shown high resistance to the streak virus in field trials were received from South Africa, and tests in which plants grown from it were exposed to infection by *C. mbila* under controlled conditions at Amani confirmed their resistance. The inbred lines are poor producers, but may provide a starting point for breeding types suited to conditions in East Africa.

Studies on the field transmission of the mosaic disease of cassava by *Bemisia* sp. [*cf.* **27** 153] showed a marked seasonal difference in the infection rate during two successive years. Cassava planted in June (the cool season) and to a lesser extent in May, July and August, maintained a high degree of freedom from the disease for the longest

time. Most of that planted between December and April was diseased within three months. This is probably true of the Usambara foot-hill region generally, and possibly of other places.

KIRKPATRICK (T. W.). **Entomology.**—*Rep. E. Afr. agric. Res. Sta. Amani* **11** 1938 pp. 20–23. London, H.M.S.O., 1939.

Two of the species of coffee leaf-miners in East Africa have been known as *Leucoptera coffeella*, Guér., and *L. daricella*, Meyr. The author considers the latter to have been wrongly named [since described by Washbourn (*Bull. ent. Res.* **30** 455–462, 1940) as a new species, *L. caffeina*]. Many of the 16 parasites recorded from Tanganyika by Ferrière [*R.A.E.*, A **25** 76] have been reared. Two of these, *Closterocerus africanus*, Wtstn., and *Teleopterus violaceus*, Ferrière, proved to be obligate hyperparasites, and *Pleurotropis coffeicola*, Ferrière, was usually primary in the Moshi district and usually secondary near Amani, though it appears to be increasing as a primary parasite of *L. caffeina*. Most of the primary parasites attacked both species, and individuals bred in one species showed no preference for that species for oviposition. *Apanteles bordagei*, Giard, however, appeared to be specific to *L. coffeella*, and was never induced to attack *L. caffeina*. Both species of *Leucoptera* were usually effectively controlled by parasites.

Other leaf-miners of coffee at Amani include a species, probably of the genus *Gracilaria*, which is confined to *Coffea arabica* and makes large irregular blotches on the lower surface of the leaves, and *Agromyza* (*Melanagromyza*) sp., which is unlikely to do appreciable damage, though the larva makes a relatively large serpentine mine just below the upper epidermis. The greater part of this mine often heals. Both species are fairly common, but appear to be effectively controlled by parasites.

KNIGHT (C. D.). **Observations on the Life-History and Control of the White Borer of Coffee in Kenya.**—*E. Afr. agric. J.* **5** no. 1 pp. 61–67, 1 fig., 2 refs. Nairobi, 1939.

Some of the information in this account of the bionomics and control of *Anthores leuconotus*, Pasc., which is an important pest of coffee in certain districts of southern Kenya and has been recorded at altitudes up to 5,300 ft., has already been noticed [*R.A.E.*, A **17** 626 ; **25** 356]. All stages of this Lamiid are described, its distribution in Africa is summarised, and the history of its occurrence in Kenya is briefly reviewed. Weak trees on impoverished soils are the most susceptible to attack, and injury is therefore more frequent at low altitudes in the Ithanga mountains than at higher ones where the soil is richer [*cf.* **15** 326]. In parts of Tanganyika, the borers chiefly attack healthy coffee near water and in shady situations, but although the larvae infest at least two wild food-plants in Kenya (one of which is *Gardenia urcelliformis*), they were uncommon where these were growing near streams.

The eggs are generally deposited under rough bark, and the egg stage lasted 20–23 days at 4,200 ft., and considerably longer at higher altitudes. It may also be prolonged by dry conditions, since eggs in short lengths of coffee stem, which dried out, hatched only after 25–30 days. The newly-hatched larvae bore downwards under the bark for

3 or 4 months, sometimes entering soft wood but leaving it again where it becomes hard, and then upwards for about 20 months through the wood, which they usually enter just below soil level. They sometimes leave the wood for short periods and feed on the outer bark. Pupation takes place in a chamber separated from the bark only by a thin layer of wood. Many pupal chambers were excavated during November - December, and in these the adults would normally emerge in March - April. They leave the chambers 2–3 weeks after emergence, generally about a week after the first heavy fall of rain. Tables show the numbers of adults collected on one estate during each of the two rainy seasons in the years 1935–37, inclusive, and during the spring rains of 1938; the numbers collected and the rainfall in each week between 3rd April and 22nd May 1937; and the numbers of males and females collected during and after the peak emergences in April and November 1937. More adults emerged during March–May than during November–December, and in 1937 the greatest numbers were taken about 17th - 24th April. Males predominated at the beginning of each peak period, but later the females were more abundant. The adults, which feed chiefly on the bark and the skin of green coffee berries, are active on bright, sunny days. The females generally lay one or two eggs in 24 hours; one that emerged on 10th November 1937 and was caged with a male deposited 40 eggs between 12th November and 15th December, inclusive, and on 16th December contained 6 mature eggs. Ten females confined on a mature coffee tree laid a total of 40 eggs in 4 days.

Considerable numbers of the larvae are destroyed by woodpeckers, and, during the early bark-boring stage, they are parasitised by *Iphiaulax varipalpis*, Cam. The eggs of this Braconid are deposited singly in the larval galleries, and the parasite larva travels along the tunnel until it reaches its host, on which it feeds externally. Pupation takes place in the gallery within a silken cocoon, and the adult escapes through a hole gnawed in the bark. Of 200 new larval galleries examined on each of three estates, 40, 147 and 137 contained living larvae of *A. leuconotus*, 85, 27 and 28 contained living larvae or pupae of *I. varipalpis*, and 75, 26 and 35 contained no living stages of either.

The control measures suggested include cultural practices to improve the condition of the soil and plants, the destruction of larvae boring under the bark [**25** 357] and in the wood [**17** 626], and the hand-collection of adults. In experiments, tar-distillate emulsions and a mixture of 5 lb. lime and $1\frac{1}{4}$ lb. sodium hydroxide in 6 gals. water were painted on parts of the stems of coffee trees as repellents, but they did not prevent the beetles from ovipositing or affect the hatching of the eggs.

JEPSON (W. F.) & WIEHE (P. O.). **Pineapple Wilt in Mauritius.**—*Bull. Dep. Agric. Mauritius* Gen. Ser. no. 47, 15 pp., 1 pl., 9 refs. Port Louis, 1939.

The history of pineapple wilt in Mauritius, where large-scale planting of pineapple was begun in 1927, is reviewed. It caused severe local damage in 1932 and 1935 and appeared on Government plantations in 1937. Experiments carried out at the beginning of the summer of 1937–38 proved that *Pseudococcus brevipes*, Ckll., was the cause.

Pineapple wilt in other countries is discussed [*R.A.E.*, A **21** 64; **23** 57, 609, etc.]. There are two forms of wilt in Mauritius, one appearing in summer and one in winter. In summer, excessive amounts of the red pigmented substance, anthocyanin, first appear in the cortical tissue of the outer whorls of leaves; the outer leaves then lose their rigidity, curl downwards at the edges and wither at the tips. The others remain bright reddish pink edged with chlorotic green. The inner whorls become slightly chlorotic and are sometimes spotted with dark green and, in the later stages, their tips acquire a slight spiral distortion. The roots decay, and small shrunken and woody fruits may be produced. In winter, the whole plant becomes slightly chlorotic and the outer leaves mottled. Anthocyanin coloration is often present in the middle of the leaf, but is brownish. The leaf-tips become necrotic. New roots grow in July and August, and there is considerable recovery in October. Commercial fruits of the higher grades are commonly obtained from such plants. The toxin, which is believed to be injected into the plant by *P. brevipes*, is not a virus in that it does not multiply in the plant tissue. It is therefore thought that severity of attack will be largely in proportion to the abundance of the mealybugs [*cf.* **25** 743], and variation in resistance according to the condition of plants is also expected. The highest incidence of summer wilt occurs from February to April and of winter wilt about June. In each case a period of recovery follows. A wilting plant may produce healthy planting material (suckers, slips and crowns). The relation between *P. brevipes* and its attendant ants, *Pheidole megacephala*, F., *Technomyrmex detorquens*, Wlk., and *Solenopsis geminata*, F., is briefly described.

The best sprays for the control of the mealybug are oils. To prevent scorching of the foliage, they must be emulsified and diluted to 1–4 per cent. Only Diesel oils and the lighter Solar distillates are economically practicable. Their emulsification with soaps proved difficult and, pending the arrival of a supply of bentonite clays [*cf.* **23** 453], local colloidal clays were tested with great success. About 10 lb. clay should be mixed with 4 gals. water and the mixture should be poured through 80-mesh gauze. The suspension should then be heated and mixed by pumping with an equal quantity of oil, and the emulsion diluted to give a spray containing 1 per cent. oil. The amount needed varies from 500 to more than 1,000 gals. per acre according to the size of the plants. Spraying should be carried out 4–5 weeks after planting out, and repeated at intervals of 6–8 weeks. Refined kerosene may be substituted for the Diesel oil in dry areas where the danger of scorching is great. An alternative emulsion is composed of 11 gals. heavy Diesel oil, 9 pints oleic acid, 60 oz. triethanolamine and 12·5 gals. water. The first and last two ingredients, respectively, should be well mixed together and the whole mixed and diluted with water (1 : 50 by volume). This spray is rather more costly than the clay emulsion, but pumping is avoided. A spray made by soaking tobacco waste in water (1 lb. to 1 gal.) for 48 hours and adding 0·7 per cent. soap is effective and does not scorch the foliage.

Supplementary control measures include the immersion of plants in oil emulsion before planting if found to be necessary on inspection, which is compulsory, clean cultivation, the provision of wind-breaks in exposed situations, and the use of fertilisers. The predacious Coccinellid, *Cryptolaemus montrouzieri*, Muls., has been imported from South Africa.

Shepard (H. H.). **The Chemistry and Toxicology of Insecticides.**—$10\frac{3}{4} \times 8\frac{1}{4}$ ins., iii+383 pp., 40 figs., multigraphed, many refs. Minneapolis, Minn., Burgess Pub. Co., 1939. Price $4.00.

Information on the toxicity of insecticides and the factors affecting it is scattered throughout the literature of economic entomology and many other sciences, and the present comprehensive work has been compiled with a view to filling the lack of a single volume of convenient size on the subject. Although the text is not merely an annotated bibliography, it is primarily a guide to the literature on insecticides, and a large number of the references from which the material is drawn are appended to each section. Methods for controlling insects are not given except to illustrate the action of specific insecticides.

Following the introduction, which includes a discussion of the chief classes into which insecticides may be divided, are three chapters of a general character. The first gives the history of insecticides. In the second are discussed certain points in the physiology of insects that affect their susceptibility to the action of toxic materials, the question of the resistance of different stages and forms to certain insecticides, and the relation of various properties of materials to their toxicity. In the third, the methods and techniques that have been devised for estimating the relative values of different toxic materials are dealt with at some length. Most of the rest of the book is concerned with individual insecticides under the headings arsenicals, non-arsenical inorganic compounds, sulphur, selenium and copper compounds, oils and their derivatives, plant derivatives and synthetic insecticides, and fumigants. These chapters include such information as the chemical and physical properties of the materials, the history of their use, methods for their application, their effect on insects, plants and mammals, and the determination of residues. The last chapter deals with attractants and repellents, dust diluents, dips and dressings, chemical bands and fly-spray testing. Various conversion tables and an index are appended.

Daniels (L. B.). **Appearance of a new Potato Disease in northeastern Colorado.**—*Science* (N.S.) **90** no. 2334 p. 273. New York, N.Y., 1939.

During the summer of 1939, many fields of potatoes in north-eastern Colorado were affected by the feeding of the Pentatomid, *Chlorochroa sayi*, Stål. The symptoms were very similar to those of Psyllid yellows, caused by *Paratrioza cockerelli*, Šulc. [*cf. R.A.E.*, A **26** 578], and consisted in wilting of the leaves and tips, a basal curling and yellowish discoloration of the terminal leaves, and, in cases of severe infestation, malformation of the tubers. Plants attacked by 3–4 bugs were only mildly affected, but those on which about 20 occurred showed extreme symptoms. In one area the percentage of plants affected amounted to 50–60.

Collins (C. W.). **The Elm Leaf Beetle.**—*Leafl. U.S. Dep. Agric.* no. 184, 6 pp., 3 figs. Washington, D.C., 1939.

A popular account is given of the bionomics of *Galerucella luteola*, Müll. (*xanthomelaena*, Schr.) on elms in the United States [*cf. R.A.E.*, A **18** 708; **20** 675; etc.]. Satisfactory control is usually a community problem, but can be obtained by one thorough application of a suitable

arsenical spray after the beetles have left hibernation and before many eggs have hatched. The formula recommended is 4 lb. lead arsenate and 1 U.S. pint fish oil or linseed oil in 100 U.S. gals. water. When outbreaks are severe, large numbers of pupae on and round the bases of the trees can be killed by sprays of nicotine sulphate (1 : 400) in 2 per cent. summer-oil emulsion or in 0·4 per cent. soap solution. In the north-eastern States, most of the beetles hibernate in house attics, barns and sheds, and it is sometimes worth while to trap them when they try to emerge in spring. Over 4,000 were thus caught in an attic and over 20,000 in a barn loft in one year. Most of the openings that admitted light were covered with black paper and the remaining windows with cellophane stretched on frames and coated on the inner side with an adhesive. As the beetles came out of hibernation, they were attracted to the light admitted through the cellophane and caught on the adhesive.

Bobb (M. L.), Woodside (A. M.). & Jefferson (R. N.). **Baits and Bait Traps in Codling Moth Control.**—*Bull. Va agric. Exp. Sta.* no. 320, 19 pp., 6 figs., 6 refs. Blacksburg, Va., 1939.

An account is given of investigations in three counties in Virginia in 1935–38 on the use of baits and bait-traps for the control of *Cydia* (*Carpocapsa*) *pomonella*, L., on apple. The technique and carrier liquids were the same as in similar experiments with *C. molesta*, Busck [*R.A.E.*, A **26** 506], and many of the same attractants were tested. In all, 45 combinations of carriers and attractants were investigated. The largest catch of moths for the experiment as a whole was given by a bait composed of 1 part stock syrup and 20 parts water with the addition of anethol at the rate of 1 cc. per U.S. quart, which was the most effective combination in southern Virginia during 1938 and in central Virginia during 1936–38, where, however, it was inferior in 1935 to a bait of stock syrup with 1 cc. safrol and several others. The largest catch obtained during any one season was given by a bait of sorghum molasses (1 : 19) and safrol. Sorghum molasses was slightly more effective than the stock syrup when each was used alone, but when anethol was added to both, more moths were caught by the latter. The addition of $\frac{1}{8}$ oz. sodium benzoate per U.S. quart of the syrup solution increased the catch during the summer months. The bait containers used for most of the work were U.S. quart oil cans, and the greatest numbers of moths were caught in new unpainted cans ; of painted cans, white ones were the least effective and those painted with aluminium paint the best. Old, rusty cans caught very few moths. In experiments with 3 traps per tree, the catch per season in traps placed near the tops of the trees (20–24 ft. above ground) exceeded the combined catch of others at heights of 12–15 and 4–5 ft. [*cf.* **15** 593]. Females, of which less than 5 per cent. had deposited all their eggs, comprised 59·8 per cent. of 686 trapped moths that were examined during 1938 [*cf.* **15** 593 ; **16** 80]. With the exception of the stock syrup alone, with amyl acetate or with pine oil, all the baits used trapped more females than males. Chemically treated bands placed on unbaited trees in 1935 caught almost six times as many larvae as those on others in which cans containing the stock syrup solution were suspended.

Since dyed moths were rarely attracted to baits at distances greater than 200 ft. from the point at which they had been liberated, the

use of one trap per tree is recommended ; they should be placed in position as soon as the adults of the over-wintered generation emerge (about 20th April in southern Virginia and 2nd May in central districts, or 10 days earlier if the beginning of April is warm).

WEHRLE (L. P.). **Grape Insects in Arizona.**—*Bull. Ariz. agric. Exp. Sta.* no. 162 pp. 274–292, 8 figs. Tucson, Ariz., 1939.

The insect pests of vines in Arizona are characteristic of the south-western United States and are, to some extent, distinct from those that occur in other parts of the country. A table is given by which they can be identified, partly by the types of injury they cause.

The adults and nymphs of the Jassids, *Erythroneura variabilis*, Beamer, and *Dikraneura cockerelli*, Gillette, feed on the lower surfaces of the leaves, which become discoloured and finally fall, retarding the growth of new wood and reducing the amount of fruit and its sugar content. *E. variabilis* overwinters in the adult stage under grass or leaves, and feeds on green plants in early spring. In southern Arizona the adults may remain active on green plants throughout the winter. They usually return to the vines during early April, and feed for a few days before beginning to oviposit. The eggs are laid singly in punctures, usually in the lower surface of the leaf, and hatch in about 18 days. There are two overlapping generations and possibly a partial third in the year. Control measures suggested include ploughing under grasses and weeds during the winter, the use of trap-crops, dusting with calcium cyanide, a vaporised spray of pyrethrum in kerosene, a spray of nicotine sulphate, and an electrocuting light-trap, all of which have been recommended against *Erythroneura comes*, Say, on vines in California [*cf. R.A.E.*, A **21** 166, 589 ; **23** 729]. A spray containing 1½ U.S. pints pyrethrum extract (2·15 gm. pyrethrins per 100 cc.), 4 lb. soap and 128 U.S. gals. water gave good control of the adults and nymphs of both *E. variabilis* and *D. cockerelli*. In California, pyrethrum extract is used in 2 per cent. summer oil emulsion, as sprays containing soap have been found to damage the fruit. This damage has not been observed in Arizona, but it is considered inadvisable to use sprays containing soap after the grapes have formed. A nicotine sulphate dust is used against the nymphs in some parts of Arizona, but is considered ineffective in others.

The larvae of *Celerio lineata*, F., and *Pholus achemon*, Dru., sometimes feed on the leaves of vines, and may do serious damage in a short time. Both have two generations a year, the adults appearing in spring and again in summer. The larvae can be controlled by hand collection and by derris sprays. The eggs of *P. achemon* are laid on the upper surfaces of the older leaves near the middle of the vine. The larvae of *C. lineata* migrate from native desert plants and usually do little damage to vines if weeds are present in the vineyard. A deep smooth furrow ploughed across the line of march, with a steep side towards the vineyard and holes about 2 ft. deep at intervals in the bottom, will prevent invasion by the migrating larvae. The larvae of *Harrisina brillians*, Barnes & McDunn., skeletonise the leaves and sometimes feed on the petioles and the fruit. They do not apparently migrate between separated plants. This Zygaenid has at least three generations a year in Arizona and hibernates in the pupal stage under loose bark on the stems. The eggs are laid on the lower surfaces of the leaves.

Control measures include destroying infested leaves, and, if the fruit has not formed, dusting with lead arsenate and lime (1 : 4), or with barium fluosilicate or sodium fluosilicate, and spraying with 3 lb. lead arsenate and 1 lb. calcium caseinate spreader in 100 U.S. gals. water. Derris dusts or sprays should be used if fruit is present. The lead-arsenate spray also controls the larvae of the Arctiid, *Estigmene acraea*, Dru., which feed on the leaves after the grapes are harvested. Derris is recommended if they become numerous before the harvest. The vineyard can be protected from the migrating larvae by a furrow similar to that used against *C. lineata*. Weeds in the neighbourhood should be destroyed.

Flea-beetles appear on the vines in early spring, when the buds are bursting, and feed on the buds, young growth and leaves. They include *Haltica torquata*, Lec., which is the most important species, *H. foliacea*, Lec., and *Gastroidea viridula*, DeG., which breeds on the leaves of canaigre [? *Rumex hymenosepalus*]. They can be controlled by clean culture, by jarring them from the buds into pans of oil, or, when they are numerous and the foliage has developed, by the lead-arsenate spray used against *Harrisina*. The same measures are effective against adults of the Eumolpid, *Myochrous longulus*, Lec., which feed on native desert plants and attack the buds of vines in spring. The Cetoniid, *Cotinis texana*, Casey, the adults of which cause serious injury to the grapes, is difficult to control [*cf.* **23** 545–547]. The fruit can be protected by enclosing the bunches in paper bags, and the beetles can be trapped in pails partly filled with sour milk. The Melolonthid, *Macrodactylus uniformis*, Horn, is widely distributed in Arizona, and oviposits in fine sandy soil. The adults sometimes invade vineyards and feed on the leaves, blossoms and young fruit in late June and July. Grass should be removed from vineyards on sandy soil, and neighbouring grassland should be ploughed in early spring. When the beetles appear, the vines should be treated with a spray containing 5 lb. lead arsenate and 2 U.S. gals. molasses per 100 U.S. gals. Adults of the Bostrychid, *Amphicerus cornutus*, Pallas, enter the vines at the leaf axils and crotches, and bore for a distance of 1–3 ins. into the fruiting stems, causing them to weaken and die. The infested parts, which are indicated by frass thrown out of the borings, should be cut out and burnt. The larvae occur in dead hardwood, such as oak.

Considerable damage is sometimes caused by cutworms, which at night feed on the buds and young growth. They can be prevented from ascending the vines by adhesive bands. Late autumn or winter ploughing destroys many of them, and if they become numerous, they can be controlled with a mash of 20 lb. bran, 1 lb. Paris green or white arsenic, 2 U.S. quarts molasses, 3½ U.S. gals. water and 3 oranges or lemons or ⅔ oz. amyl acetate, scattered through the vineyard in the evening. This mash should also be scattered over infested areas early in the morning to control grasshoppers, which defoliate cuttings and young vines in early May. The Lygaeid, *Nysius ericae*, Schill., which overwinters in all stages, breeds on wild food-plants and, when they dry up, migrates in swarms to cultivated plants, including vines. Infested weeds should be sprayed with oil and burnt, and infested vines should be sprayed with pyrethrum or with nicotine sulphate and soap. Thorough irrigation or repeated cultivation of the invaded area controls migrating nymphs. Other pests of vines in Arizona are *Colaspis brunnea*, F., the adults of which feed on the leaves, *Clastoptera*

obtusa, Say [**14** 64], which sucks the juices of the plants, and *Phylloxera vitifoliae*, Fitch, which occurs on wild grapes at altitudes above 3,000 ft. and occasionally on cultivated vines in northern districts.

Watson (J. R.) & others. **Entomology.**—*Rep. Florida agric. Exp. Sta. 1937–38* pp. 82–86, 106. Gainseville, Fla. [1939.]

Some of the information in this report on work in Florida in 1937–38 has already been noticed [*R.A.E.*, A **26** 131; **27** 654]. *Leis dimidiata* ab. *quinquedecimspilota*, Hope, gave commercial control of the green citrus aphis [*Aphis spiraecola*, Patch] in the three counties in which it is established, and was liberated in other counties. This Coccinellid was observed feeding in summer on the leaves of *Baccharis halimifolia* and on the honeydew from *Peregrinus maidis*, Ashm., on both maize and Napier grass [*Pennisetum purpureum*]. Since the latter grows throughout the summer, it is considered that it would provide a better means of carrying the Coccinellid over than maize, which usually becomes too mature for *P. maidis* in June or July [*cf.* **22** 693; **26** 727]. Damage to a crop of economic importance due to *Frankliniella insularis*, Frankl., was observed for the first time in Florida, on beans in Pinellas County. The Florida flower thrips, *F. cephalica bispinosa*, Morg., was scarce on *Citrus* early in the spring, but became very abundant later, during severe drought. *Nezara viridula*, L., caused little damage to oranges and was scarce in the peninsula, but severely injured maize in the west of the State. It is considered that an outbreak of this Pentatomid can be predicted from the degree of parasitism in the previous autumn [*cf.* **26** 727].

Onion sets brought into the State were found to be a source of infestation by *Thrips tabaci*, Lind. Dipping the sets in a pyrethrum extract twice, at an interval of 10 days, gave good control. *Taeniothrips simplex*, Morison, was scarce on gladiolus in early autumn and confined to plants left in the field during summer, but it had become very abundant in all gladiolus fields by the following April and no blossom was obtained from fields in which control measures had not been applied. The best control was given by a spray of tartar emetic and brown sugar [**26** 552]. From the local distribution of infestation of peppers [*Capsicum*] by *Anthonomus eugenii*, Cano [*cf.* **26** 64], it was evident that complete destruction of the plants at the end of the picking season in late spring affords a very effective method of control. If practised throughout the infested area, it might enable the weevil to be exterminated in a year or two.

The gall-forming Aphids, *Eriosoma americanum*, Riley, *Georgiaphis ulmi*, Wilson, and *Colopha graminis*, Monell, were observed on elms in Florida for the first time. Infestation of maize by *Aphis maidis*, Fitch, was unusually severe in one field in late June, though it was soon terminated by natural enemies or heavy rain. The Aphids not only infested the stalks but also appeared to be injuring the tassels and upper leaves. It was found that the green pods of cowpea [*Vigna sinensis*] could safely be fumigated with methyl bromide, and fumigation with half the basal dosage [of 2·5 lb. per 1,000 cu. ft. for 90 minutes] gave complete control of larvae and adults of the cowpea pod borer, *Chalcodermus aeneus*, Boh. It also controlled larvae of *Keiferia* (*Gnorimoschema*) *lycopersicella*, Busck, on tomato without injury to the plants.

THOMPSON (W. L.). **Control of Purple Scale and Whiteflies with Lime-sulfur.**—*Rep. Florida agric. Exp. Sta. 1937–38* pp. 146–147. Gainesville, Fla. [1939.]

Observations in Florida showed that infestation by *Lepidosaphes beckii*, Newm., had increased on *Citrus* that had received 3 applications in 1936 and 1 in 1937 of sprays containing combinations of zinc and sulphur. The increase was greater when lime-sulphur was added to either zinc sulphate or zinc oxide than when wettable sulphur was added. The control of the rust mite [*Phyllocoptruta oleivorus*, Ashm.] was not affected. After three years, trees that had received 4–5 applications per year of lime-sulphur (2 : 100) were less vigorous than those sprayed with 90 per cent. wettable sulphur (7½ lb. per 100 U.S. gals.) and had more bronzed leaves. Those treated with one application of an oil emulsion per year were as healthy as those sprayed with wettable sulphur. Leaf drop was heavier after lime-sulphur than after wettable sulphur, but there was little difference in the total yearly leaf drop. Counts showed that there were usually more scales on the lower surface of the leaves than on the upper, and at least four times as many on the leaves of inside branches as on those outside. It was found that 10 per cent. more material was used and 30 per cent. greater reduction of infestation obtained with oil emulsion when the inside of the tree was sprayed from underneath, instead of from outside with the spray gun through the foliage.

Eulia (*Tortrix*) *citrana*, Fern., was unusually plentiful on young grapefruit, and to some extent on mature oranges and grapefruit, in the spring of 1938, but the larvae had become scarce by 1st June. In groves in which the fruit was heavily infested by *L. beckii*, the predacious larvae of the Pyralid, *Laetilia coccidivora*, Comst., were numerous on infested fruit, and sometimes bored into them or fed on the rind under the calyx of young fruit.

Los Citrus.—*Bol. Frut. Hortal.* **4** no. 39, 282 pp., illus. Buenos Aires, 1939.

This bulletin on the cultivation of *Citrus* in Argentina contains a chapter (pp. 198–253) by K. J. Hayward in which notes are given on the morphology, bionomics and control of the principal insects and mites that attack *Citrus* there, and on the types of injury that they cause. Most of them are Coccids. The control measures recommended include the application of various sprays, directions for the preparation of which are given.

In another chapter (pp. 254–262), A. Vergani discusses the control of insect pests of *Citrus* in Argentina by the biological method. A list is given of entomogenous fungi observed in Argentina, and it is stated that although some workers have obtained promising experimental results, the use of such fungi is restricted by the fact that their development requires a combination of specially favourable environmental conditions. The most important of the Coccinellids that are predacious on Coccids in Argentina is *Rodolia cardinalis*, Muls., though it is only effective against *Icerya purchasi*, Mask., against which it was introduced in 1929 [*cf. R.A.E.*, A **23** 366]. Some information is included on parasites and predators of other *Citrus* pests, and the desirability is emphasised of establishing in Argentina parasite laboratories similar to those common in the United States and elsewhere.

Froggatt (J. L.) & Moody (F. O.). **Copra Infestation by** *Ephestia cautella*, **Wlk.**—*New Guinea agric. Gaz.* **5** no. 2 pp. 2–5, 2 refs. Rabaul, 1939.

Infestation of copra by *Ephestia cautella*, Wlk., is sometimes severe in the Territory of New Guinea, though well dried material, with a moisture content of not more than 5 per cent., will remain free from insects for long periods. Investigations have shown that the infestation usually begins in the storage sheds on plantations, owing to the practice of putting the copra into bags the day after it is taken off the drier, although it does not become completely dry for a further 4–5 days. The resultant sweating in the bags encourages infestation. To prevent this, the copra should be heaped up in a well ventilated weather-proof shed for several days and turned over each day ; at the same time, material of poor quality should be removed. The exposure of the bags to cold winds at night, which leads to the condensation of moisture, or to rain during storage, and loading to vessels in wet weather, favour the development of moulds, which attract insects [*cf. R.A.E.*, A **26** 31]. Other preventable causes of infestation by *E. cautella* are storage of copra and rice in the same or adjacent sheds, and the use of sacks in which rice has been kept [*loc. cit.*]. When a copra shed is emptied, it should be thoroughly cleaned and sprayed with kerosene to kill the larvae, pupae and adults. Fumigation of individual sheds would be too costly, but incoming copra that shows a sufficient degree of infestation to warrant the expense might be fumigated in a special chamber. The possibility of control in the sheds by an atomised spray of pyrethrum extract in white oil [**24** 191] deserves investigation.

Nicholas (H. S.). **Entomological Notes.**—*Aust. Nat.* **10** pt. 4 pp. 138–141. Sydney, 1938. [Recd. 1940.]

The insects dealt with in these notes include the Limacodid *Doratifera oxleyi*, Newm., the larvae of which completely defoliated many *Eucalyptus* trees near Scone (New South Wales) in 1934. There is only one generation a year. The eggs are deposited in masses on the leaves in May and June, and the larvae feed throughout the winter and early spring and pupate in October in cup-like cocoons on twigs, sticks, etc. Adults emerge in April, May and June. Some individuals remain in the prepupal stage in the cocoon for 18 months before pupating. Adults from such individuals reproduce normally. In 1934, many larvae were destroyed by Reduviids. Parasites that emerged from the cocoons in 1933 comprised a species of *Eurytoma*, a Eulophid and an Ichneumonid.

Cottier (W.). **Citrus Pests (No. 8) : The Leaf-roller Caterpillar and other Insects.**—*N. Z. J. Agric.* **59** no. 1 pp. 47–48, 3 figs., 1 ref. Wellington, 1939.

In this paper, which is one of a series [*cf. R.A.E.*, A **28** 49], brief notes are given, partly from the literature, on the bionomics and distribution of the Tortricids, *Ctenopseustis obliquana*, Wlk., *Tortrix excessana*, Wlk., and *T. postvittana*, Wlk., which attack fruit trees and many other plants in New Zealand [*cf.* **21** 91 ; **22** 477 ; **26** 57] and are sometimes injurious on *Citrus*. The adults and larvae are briefly described. There are usually about three generations annually, and

the adults can be found on *Citrus* at almost any time of the year, but are most abundant in summer. The egg and pupal stages last about 14 days each, and the duration of the larval stage varies from one to six months, depending on the time of the year. The larvae are typical leaf-rollers but are of importance as pests because they cause blemishes on the skin of the fruits. Lemons and oranges are attacked when about half-an-inch long. Sometimes a hole is bored right into the fruit. The larvae can be controlled by a spray of 1·5 lb. lead arsenate in 100 gals. water, but it should be used sparingly on *Citrus* as arsenicals are known to affect the taste of the fruit.

Other insects that are observed on *Citrus* in New Zealand, but are not of economic importance, include the Ricaniid, *Scolypopa australis*, Wlk., and the Flatid, *Sephena cinerea*, Kirk.

ROBERTSON (P. L.). **Diamond-back Moth Investigation in New Zealand.**—*N. Z. J. Sci. Tech.* (A) **20** nos. 5–6 pp. 330A–364A, 10 figs., 36 refs. Wellington, N.Z., 1939; also as *Bull. Dep. sci. industr. Res.* [*N. Z.*] no. 78, 35 pp., 10 figs., 36 refs. Wellington, N.Z., 1939.

Plutella maculipennis, Curt., is an important pest in New Zealand of cruciferous crops grown for fodder, on which the use of insecticides is impracticable, and investigations were therefore carried out on its bionomics and the extent to which it is attacked by natural enemies, as a basis for further work on its control by means of imported parasites [*cf. R.A.E.*, A **28** 27]. The literature dealing with its life-cycle and importance and the extent to which it is parasitised in various parts of the world is summarised; all stages are described, and characters are given distinguishing the four larval instars, which conform approximately to Dyar's Law [**17** 178]. The author concludes that the presence or absence in various regions of a hibernating period during the life-cycle is determined by the intensity of cold during the winter and not by independent physiological factors.

The eggs are laid on the leaves of the food-plant, singly or in groups of up to 20. A table shows the total numbers deposited in the laboratory by nine females fed on diluted honey. The longevity of the females varied from 11 to 28 days; the two that lived for 28 days deposited 427 and 176 eggs, and the two that lived for only 11 days 175 and 87. Another table shows the duration at temperatures approximating to those out-of-doors of the 4 larval instars in 20 individuals; 12 that hatched on 20th February completed the larval stage in 12–17 days at an average daily mean temperature of 63·4°F., and 2 and 6 that hatched on 5th and 12th March did so in 17 and 19–24 days at average daily mean temperatures of 57·4 and 56·7°F., respectively. When fully grown, the larvae frequently migrate to dead leaves on the ground or to cruciferous weeds, where they construct cocoons in which, under laboratory conditions, they remained for 1½–2 days before pupating. The adults shelter under the leaves of the food-plant by day, and become active at dusk.

Field surveys were made in summer during 1935–37 in a number of the most important crucifer-growing areas, chiefly in the North Island, on six kinds of cruciferous crops, and the results for each area are discussed. Ichneumonid parasites reared from the pupae were identified by the Imperial Institute of Entomology as undescribed species of *Angitia* and *Diadromus*; the former, which attacks the

larvae and was previously recorded as resembling *A. lateralis*, Grav. [**19** 141], was the more abundant. Both sexes of *Diadromus* are described, and characters are given distinguishing the species of *Angitia*, the adults of which showed considerable morphological variations, from *A. lateralis*, *A. chrysosticta*, Gmel., *A. fenestralis*, Hlmgr., and *A. cerophaga*, Grav., which are the species most closely allied to it and of which the last two are important parasites of *P. maculipennis* in England [*cf.* **27** 262; **28** 28]. The percentage parasitism was negligible during the period in which *P. maculipennis* is most destructive, except in the South Island during 1937, where, however, it is considered that a high degree of parasitism at midsummer is not usual. In one district in the North Island, it increased to about 50 during the autumn of the same year, after a cool wet summer that was unfavourable to the moth. A Pteromalid hyperparasite, *Eupteromalus* sp., was bred from pupae and prepupae of *Angitia* in 1937, but only 3 per cent. of them were parasitised by it. The inefficiency of the native parasites is attributed to their apparent inability to increase under climatic conditions favourable to the moth.

Larvae and pupae of *P. maculipennis* were attacked by *Entomophthora sphaerosperma*, which caused high mortality in cool wet weather during the autumn of 1935 and the summer of 1936–37, but was not normally prevalent at the time when most damage was done to the crops. Field observations confirmed data in the literature indicating that a high degree of infestation by this fungus occurs only when the humidity is high, the temperature moderate (about 68°F.) and the host crowded. It also infests *P. maculipennis* in Europe, but not to any significant extent. It is too dependent on weather conditions to be of great value in control, but is nevertheless one of the most important factors involved in the reduction of *P. maculipennis* in New Zealand, probably because the larvae and pupae are crowded in autumn owing to the absence of efficient insect parasites. It may increase the difficulty of establishing introduced parasites. The only other natural enemies of *P. maculipennis* known in New Zealand are the Syrphids, *Syrphus novae-zealandiae*, Macq., and *Melanostoma fasciatum*, Macq., which have been recorded as preying on the larvae [**7** 49] but are considered to exert little control.

TOUMANOFF (C.). **Les ennemis des abeilles.**—*Bull. écon. Indochine* **41** fasc. 5 pp. 1062–1116, 10 pls., 40 refs. Hanoi, 1938. *Op. cit.* **42** fasc. 1 pp. 100–124, 6 pls., 29 refs.; fasc. 3 pp. 521–564, 20 pls. 1939.

This is a detailed review of data on the insect enemies of honey bees in various countries, particularly France and Indo-China. It is written chiefly in view of possibilities of the development of apiculture in Indo-China and is designed to facilitate the recognition of the pests that may occur there. The first part deals with Hymenoptera (wasps, ants and bumble-bees), the second with Lepidoptera, and the third with other insects.

HERFORD (G. M.). **Common Pests of Grain Godowns in Hong Kong.**—*Hong Kong Nat.* **9** no. 3 pp. 102–107, 2 refs. Hong Kong, 1939.

In October and November 1937, the author carried out observations on insect pests in warehouses in Hong Kong. Unpolished rice was

attacked by *Rhizopertha dominica*, F., and first quality polished rice and broken rice were infested by *Calandra oryzae*, L., and *Tribolium castaneum*, Hbst. *T. castaneum* breeds rapidly in rice that has previously been broken down by *C. oryzae*. Other pests of broken rice were *Dinoderus minutus*, F., which is not numerous in Hong Kong, and *Laemophloeus minutus*, Ol. (*pusillus*, Schönh.). Fresh rice meal was attacked by *Ephestia kuehniella*, Zell., and *T. castaneum*. Other records were *C. oryzae* and *T. castaneum* in stored maize, *Bruchus* (*Callosobruchus*) *chinensis*, L., in gram [*Cicer arietinum*], and *Lasioderma serricorne*, F., in pressed copra. *C. oryzae* was parasitised by *Lariophagus distinguendus*, Först. A key is appended to the adults of the Coleoptera mentioned.

Konyil Chan. **Notes on Vegetable Insect Pests in Hong Kong. Part 1.**—*Hong Kong Nat.* **9** no. 4 pp. 199–202, 2 figs. Hong Kong, 1939.

Brief descriptions are given of all stages of *Pieris canidia*, Sparrm., the larvae of which cause great injury to cruciferous crops in Hong Kong. The egg and larval stages last 3–5 and 24 days, respectively, and the pupal stage about one week in summer, two in spring and three in cold weather. The most practicable method of control is to collect the eggs, larvae and pupae throughout the season. Derris sprays have given promising results.

[Yakhontov (V. V.).] **Яхонтов (В. В.). Note sur *Alophia combustella* H. S. (Lepidoptera) se nourrissant des pucerons sur le pistachier.** [*In Russian.*]—*Bull. Soc. Nat. Moscow* Sect. biol. N.S. **47** no. 4 pp. 279–284, 3 figs., many refs. Moscow, 1938. [Recd. 1940]. (With a Summary in French.)

Brief descriptions are given of the larva, pupa and adult of the Pyralid, *Alophia combustella*, H.-S., the larvae of which were observed preying on the Aphids, *Forda hirsuta*, Mordv., and *Geoica* (*Slavum*) *lentiscoides*, Mordv., in galls on the leaves of pistachio (*Pistacia vera*) in the region of Tashkent.

Miles (H. W.). **Wireworms and the Breaking up of Grass Land.**—*Agriculture* **46** no. 5 pp. 480–488, 4 pls. London, 1939.

Wireworms are the most important of the insects that cause losses of crops grown on ploughed grassland in Great Britain. They occur throughout the country, particularly on light and medium soils, and old grassland may contain from 500,000 to over 1,000,000 per acre. An account is given of the life-history of wireworms in Britain [*cf. R.A.E.*, A **27** 96], where the commonest and most widespread is *Agriotes obscurus*, L. The adults are present between late March or early April and June, and the females oviposit just below the surface of the soil, usually in June. They prefer damp soil, and there is some evidence that, in addition to rough grassland, they select soil under wheat, oats or first- and second-year grass mixtures, probably because the humidity is more suitable than under root or market-garden crops, where there is a considerable area of exposed soil in June. The eggs hatch in 4–6 weeks, usually during July and early August. The larvae descend into the soil and feed at first on humus, decaying vegetation and manure; they have become able to

damage sound plant tissue by the end of their second winter. Those of *A. obscurus* feed for 4½ or 5 years before pupating, and therefore damage may be expected to recur for at least 3 years. Arable land may become reinfested, but the population is unlikely to be large, as there is little shelter for the adults. The greatest injury usually occurs in the second season after ploughing, as the larvae feed on the undecayed turf in the soil during the first season. Crops susceptible to a reduction in market value as well as yield should be avoided in the second year. Investigations during two seasons after ploughing showed that injury to potatoes was greater than that to wheat in both years. The chief damage to potatoes occurred in autumn, when the wireworms moved towards the surface of the soil and attacked the tubers. At this time only stubble remained in the wheat fields. It is suggested that mid-season potatoes should be grown during the first season [*cf.* **27** 97], and cereals, in spite of their susceptibility to attack, during the second. Varieties with high tillering power should be chosen, and a complete fertiliser should be used in the seedbed to encourage rapid growth. Some advantage is gained by using rather more seed than usual and sowing it both along and across the ploughing. Suitable crops for the third year after grass appear to be peas, beans and crucifers, which do not seem to be particularly susceptible to wireworm attack.

Control measures [*cf. loc. cit.*] include the reduction of shelter for the adults in spring, by ploughing or close grazing, and tillage during June, July and August to expose the eggs and young larvae to unfavourable temperatures and humidities and the pupae to predators. It is recommended that grassland should be heavily stocked during May and June to reduce the grass cover for two or three years before ploughing, ploughed to a depth of 8 ins. or more directly after midsummer or the first cut of hay, and then worked as often as possible until the end of September. The method of breaking up the grassland for different crops is discussed.

VENTRE (J.). **Contribution biochimique à l'étude des vins eudémisés.**—*Ann. Éc. Agric. Montpellier* **25** fasc. 3–4 pp. 203–253, 3 pls., 2 graphs, 23 refs. Montpellier, 1939.

This is a detailed discussion of the causes and effects of the chemical changes that occur in wine made from grapes attacked by *Polychrosis botrana*, Schiff. They are initially due to the action of an acidifying bacterium that occurs in the lesions made by the larvae in the grapes, and they give the wine a characteristic flavour that distinguishes it from the product of sound grapes.

MANOLACHE (C. I.). **Un dăunător al seminţelor de** *Coriandrum sativum* **"** *Systole coriandri* **Nicol." (Hym. Chalcididae).** [A Pest of the Seeds of *C. sativum*, *S. coriandri*, Nik.] [*In Rumanian.*] —*Progr. hort.* no. 1 repr. 2 pp., 2 figs., 9 refs. Bucharest, January 1939. (With a Summary in German.)

The Eurytomid, *Systole coriandri*, Nik., which had previously been recorded only from the Russian Union [*R.A.E.*, A **25** 400], was found in August 1934 to be infesting fruits of coriander (*Coriandrum sativum*) cultivated near Bucharest. About 8 per cent. of the fruits had been perforated by the emerging adults; most of them showed only one

exit hole and a few two. The adults were reared from a single fruit, and all of them were females. The larvae feed and pupate in the seeds. Subsequent observation showed that the adults emerge in some years before the harvest and in others after it.

VEREŞCEAGHIN (B. V.). **Patologie vegetala. Protecţia plantelor agricole.** [Plant Pathology. Protection of cultivated Plants.] —Med. 8vo, 210 pp., 50 figs., 8 refs. Chişinău, 1939. Price 90 *lei*.

About half of this popular handbook, which is based partly on the literature and partly on personal investigations, is concerned with insect pests. It contains chapters that deal in a general way with the importance of the pests and diseases of cultivated plants and methods for their control, with the characteristics of different orders and families of insects, and with natural enemies of insect pests. A section of 68 pages is devoted to the bionomics and control of insects injurious to vines, fruit trees, vegetables, field crops, and stored grain in Rumania, and a briefer section to insecticides and apparatus for spraying and dusting.

STELLWAAG (F.). **Oelemulsionen zur Abtötung der Winterpuppen des bekreuzten Traubenwicklers.** [Oil Emulsions for killing the Winter Pupae of *Polychrosis botrana*.]—*Anz. Schädlingsk.* **15** pt. 9 pp. 97–105, 2 figs., 5 refs. Berlin, 1939.

The author supplements information already given [*R.A.E.*, A **27** 103] on winter sprays against the pupae of the vine moths, *Clysia ambiguella*, Hb., and *Polychrosis botrana*, Schiff., and describes further laboratory and field experiments in Germany on the use of mixtures of contact poisons and quick-breaking mineral oil emulsions, mainly against *P. botrana*. The work covered 1,160 series of experiments in which all the usual contact poisons were tested and also about 100 not obtainable commercially. Complete mortality of winter pupae of *P. botrana* was given by suitable 2 per cent. oil emulsions combined with 0·3 per cent. crude nicotine, 0·2 per cent. nicotine, 0·5 per cent. rotenone or 1 per cent. of a preparation of pyrethrum (the last three being proprietary products) and by 3 per cent. emulsions with 0·2 per cent. crude nicotine. Tests with the liquid at the bottom of a litre flask 6 hours after the emulsion had broken showed that it had lost its toxicity, and the mortality due to nicotine could not be determined. Only uniform emulsions should therefore be used, and the vine stock should be sprayed until the bark is dripping all over to ensure the pupae being thoroughly wet for some time [*cf.* **27** 689].

In a field experiment in 1938, no larvae of *P. botrana* were observed on 182 flower clusters on 44 stocks treated in March with 2 per cent. oil emulsion combined with 0·15 per cent. proprietary nicotine and covered by a wire gauze cage, whereas 201 larvae were found on 174 clusters on untreated vines nearby. In 1939, 3 larvae were found on 200 clusters on 88 stocks treated in April with oil emulsion combined with a pyrethrum preparation and covered by a cage, while 65 larvae were found on 200 clusters on untreated vines.

At the end of the winter of 1939, field work was carried out on a large scale with oil emulsions and 0·2 or 0·3 per cent. nicotine, but the desired mortality of 95 per cent. was not attained. This is attributed to inexperience in the use of unstable materials. Similar

experiments by Jancke & Roesler [**27** 689] are discussed, and it is suggested that the poor results obtained may have been due to failure to apply the oil emulsions before they broke. None of the insecticides injured the vines even if the buds were brushed with them.

Oil emulsions combined with nicotine quickly killed larvae of *Sparganothis* (*Oenophthira*) *pilleriana*, Schiff., in June. They also controlled the mites, *Epitrimerus vitis*, Nal., and *Eriophyes vitis*, Land., and mealybugs. They are less effective against the pupae of *Clysia ambiguella*, as these lie in the webs together with foreign bodies that are not readily wettable. *P. botrana* is, however, the chief vine moth in Germany at present.

ERLER (E.). **Beobachtungen zur Oekologie und Bekämpfung des Eichenwicklers** (*Tortrix viridana* **L.**) **in Westfalen.** [Observations on the Ecology and Control of the Oak Tortrix in Westphalia.]—*Anz. Schädlingsk.* **15** pt. 9 pp. 105–108, 1 fig., 13 refs. Berlin, 1939.

This is the second part of a paper on *Tortrix viridana*, L., attacking oaks in Westphalia [*cf. R.A.E.*, A **28** 56]. Not all oaks in uniform stands were infested, and observations are to be continued on certain trees that escaped attack. Although mixed stands are advocated by foresters, these do not always afford protection, as in one such stand oaks interspersed with beech were severely infested.

Control measures cannot be applied without a preliminary forecast of infestation. As this cannot be made by counting the eggs [*cf. loc. cit.*], the best way would be to examine and count the pupae or possibly to estimate the adult flight. Until a reliable method of forecasting can be developed, expert observation of the first-instar larvae will be necessary in order to determine whether control measures are required. Experiments on the use of dusts were made against larvae on oak in field cages with Forestit, which is a contact poison of unstated composition [**20** 314], Detal, which contains dinitro-cresol, and Forstesturmit, which contains calcium arsenate. Complete control was given by Detal at a rate equivalent to 45 lb. per acre in May, in spite of rain, but the other dusts were unsatisfactory. Larvae that survive dusting with Detal are deprived of food owing to the scorching of the leaves, and the latter are soon replaced without injury to the growth of the tree. Detal decomposes within two days and is then harmless [*cf.* **25** 525].

GÖTZ (B.). **Ueber weitere Versuche zur Bekämpfung der Traubenwickler mit Hilfe des Sexualduftstoffes.** [On further Experiments in combating Vine Moths by Means of the Sex Scent.]—*Anz. Schädlingsk.* **15** pt. 10 pp. 109–114, 2 figs., 6 refs. Berlin, 1939.

In further work in the Rhineland on the attraction of the males of the vine moths, *Clysia ambiguella*, Hb., and *Polychrosis botrana*, Schiff., by the scent of the unfertilised females [*R.A.E.*, A **27** 582], the author investigated the value of this attraction as a measure of control and also made experiments to ascertain whether the daily catches in glass bait-traps [*loc. cit.*] agreed with those in traps containing females (S-traps).

The S-trap used is described and illustrated. The container for the females is a vertical cylinder of gauze, 8 ins. high, closed at either end by a cork 2 ins. in diameter, these corks being held in position by a

central wooden rod. This container is placed vertically on the centre of a square wooden base (with sides about 8 ins. long), and from it 4 wooden partitions radiate to the corners of the base. Both surfaces of each of these 4 wings are covered with white paper coated with adhesive.

The first experiment was made in the spring of 1939, when an S-trap was placed on a post 4 ft. high among vines covered by a cage measuring about $16 \times 10 \times 6\frac{1}{2}$ ft. The flight of the overwintered generation lasted from 21st May to 12th June, with a peak on 2nd June. Males of both species were caught. On 27th June, 200 clusters inside the cage were examined and 4 larvae of *P. botrana* and 1 of *C. ambiguella* were found, whereas 65 larvae of *P. botrana* and 15 of *C. ambiguella* were found on 200 clusters outside the cage on vines that had not been treated with an insecticide.

A similar test was made against the summer generation. The trap contained an average of 6 females of *P. botrana* and 2 of *C. ambiguella* and they were replaced by fresh ones at intervals of about 3 days from 14th July to 5th August; during this period, it caught a total of 72 males, including both species. On 29th August, 3 larvae of *P. botrana* and 22 of *C. ambiguella* were found on 200 clusters in the cage, and 14 of *P. botrana* and 173 of *C. ambiguella* on 200 clusters outside it on vines sprayed once with an arsenical and once with nicotine.

In experiments in a district in which *P. botrana* predominated, two bait-traps were placed 55 and 82 yards from an S-trap in each of two open vineyards in July–August. The numbers of females in the S-traps (2–11) and the frequency with which they were replaced varied with the material available. The daily catches are tabulated. The numbers of males of *P. botrana* caught in the two S-traps were 5,055 and 1,699, while the adults caught in the two pairs of bait-traps numbered 199 and 72. Of these, 132 and 32 were males.

The numbers of males caught in S-traps depended on weather and the number and age of the females in the traps. Unfertilised females remain attractive throughout their life, the scent being stronger on the second day after emergence than on the first. For practical work it will be necessary to analyse the scent and droduce it synthetically.

Reinmuth (E.) & Kirchner (H. A.). **Schutz des Saatgetreides vor Kornkäferbefall durch Beizmittel.** [The Protection of Cereal Seed against *Calandra granaria* by Means of Seed Disinfectants.]—*Anz. Schädlingsk.* **15** pt. 10 pp. 115–117, 3 figs. Berlin, 1939.

The author investigated in 1938–39 the possibility of protecting wheat for sowing from infestation by *Calandra granaria*, L., by applying seed disinfectants earlier than usual. Six proprietary preparations of German manufacture were applied in November, and one gave very good protection until the following April.

Steiner (P.). **Ist verblautes Holz vor Hausbockbefall geschützt?** [Is Blue-stained Timber protected against Infestation by *Hylotrupes bajulus*?]—*Anz. Schädlingsk.* **15** pt. 11 pp. 125–128, 5 refs. Berlin, 1939.

It has been shown by K. Schuch that the larvae of *Hylotrupes bajulus*, L., attack sapwood almost to the exclusion of heartwood [*R.A.E.*, A **27** 204], and it is suggested by the author that this is due to the fact

that sapwood contains parenchymatic cells. Cellulose, of which the cell-walls of both sapwood and heartwood consist, is inadequate for larval nutrition. Blue-stain fungi, such as species of *Ceratostomella*, also prefer the sapwood of pine, and as they consume the contents of the parenchymatic cells and leave the cell-walls untouched, the strength of the wood is not affected.

It might be assumed that no nutritious material is left for the larvae in wood affected by blue-stain, but some workers consider that infection by the fungi affords no protection against *H. bajulus*. The author has constantly observed that blue-stained timber is attacked by the larvae and describes tests showing that young larvae increased their weight by an average of 47·2 per cent. in 6 months in blue-stained wood as compared with 36 per cent. in unstained wood. Although this difference was not statistically significant, it disproves the view that stained timber is protected against attack by *H. bajulus*.

PAWLAKOS (J.). *Rhaphidopalpa foveicollis* **Luc., als Melonenschädling in Griechenland und seine Bekämpfung.** (**Vorläufige Mitteilung.**) [*R. foveicollis* as a Pest of Melons in Greece and its Control. (Preliminary Communication.)]—*Anz. Schädlingsk.* **15** pt. 11 p. 130. Berlin, 1939.

Rhaphidopalpa foveicollis, Lucas, is one of the most important pests of melons in Greece. In irrigated fields, the damage caused by the larvae in the soil is the most serious, while in non-irrigated fields, the injury is limited to adult feeding on the leaves. In Argolis and Corinthia, this Galerucid has one generation a year, and development from egg to adult lasts 47–55 days.

In experiments, the adults were controlled by 1 or 2 applications to the leaves of a bait-spray containing 2·5 per cent. barium fluosilicate or sodium fluosilicate and 6 per cent. sugar. The larvae were controlled in 55–60 per cent. of the cases by watering the soil beneath the plant (in such a manner as to wet the roots and underground part of the stem) with 50 cc. of a 10 per cent. mineral-oil emulsion or of a 0·6 per cent. solution of nicotine sulphate.

HASE (A.). **Ueber den Pinienprozessionsspinner und über die Gefährlichkeit seiner Raupenhaare** (*Thaumetopoea pityocampa* **Schiff.**). [On the Pine Processionary and on the Dangerousness of the Hairs of its Larva.]—*Anz. Schädlingsk.* **15** pt. 12 pp. 133–142, 11 figs., 28 refs. Berlin, 1939.

An account is given of observations made from 1925 to 1928 in Spain on *Thaumetopoea pityocampa*, Schiff., which infests pines and firs [*Abies*] throughout Spain and Portugal.

Adults and eggs are found from the beginning of July to mid-August, larvae from mid-August to mid-May, and pupae, which occur in the soil, from mid-May to the end of June. A table shows the chief differences in the life-histories of *T. pityocampa*, *T. processionea*, L., and *T. pinivora*, Treit., which overwinter in the larval, egg and pupal stages, respectively. The larval nests of *T. pityocampa* and their construction are described from laboratory observations in Berlin on nests collected in Spain. Nests collected at about 3,300–3,600 ft. in the Guadarrama region contained from 31 to 315 larvae, and some contained larvae of different sizes. On the southern slopes of the Pyrenees *T. pityocampa* has been

observed at 6,300 ft. Larvae from *Pinus maritima* in Spain fed on needles of *P. sylvestris* in Germany.

The concluding part of the paper comprises an account of the investigations on the urticating hairs of the larvae [*R.A.E.*, B **28** 72].

THALENHORST (W.). **Zur Biologie des Kiefernspannerparasiten *Ichneumon nigritarius* Grav.** [A Contribution to the Biology of *I. nigritarius*, a Parasite of the Pine Geometrid.]—*Z. angew. Ent.* **26** pt. 2 pp. 185–208, 6 figs., 20 refs. Berlin, 1939.

An outbreak of the pine Geometrid, *Bupalus piniarius*, L., that occurred in the district of Letzlingen, Saxony, in 1937 enabled laboratory investigations to be made on the biology of *Ichneumon nigritarius*, Grav., which is the most important of its parasites. The larvae and pupae of this Ichneumonid are numerous in the hibernating pupae of *B. piniarius*, and the adults appear in May and June, usually well before those of the moth.

In the laboratory, the first adults emerged on 22nd April, and the peak of emergence occurred in the first half of May, that of the males a few days before that of the females. Males and females fed on diluted honey survived for maximum periods of 57 and 90 days at 10°C. [50°F.], 54 and 65 at 15°C. [59°F.], 25 and 52 at 20°C. [68°F.] and 12 and 44 at 25°C. [77°F.]. In the field, they probably live for about 30 and 50 days. The thermal limits of activity were about 0 and 42°C. [32 and 107·6°F.] for males and about 0 and 50°C. [122°F.] for females. A list is given from the literature of other Lepidoptera that serve as hosts for *I. nigritarius*; the most important of these is *Panolis flammea*, Schiff. Adults bred from different hosts vary considerably in size, but whether this represents racial differences has not been determined. Males bred from *P. flammea* paired with females from *B. piniarius*.

Oviposition occurred in pupae of *B. piniarius*, *P. flammea* and other Lepidoptera, but not in the larvae, which appeared to repel ovipositing females. Development from oviposition to adult emergence required 22–29 days at 20–22°C. [68–71·6°F.], the average being 26 days. Second-generation adults appeared after about 31 days at 18–20°C. [64·4–68°F.] from eggs laid in August in pupae of *P. flammea*.

Conflicting views are quoted as to the number of generations of *I. nigritarius* that occur in the year and the hosts in which it survives the summer [*cf. R.A.E.*, A **14** 415; **19** 615]. In the author's observations, adult parasites emerged in September from pupae of *P. flammea* and oviposited in October in pupae of *P. flammea* and *B. piniarius*. It is considered that these adults must have developed from eggs deposited in early August either by the first-generation progeny of the adults that emerge in May–June or by those of a second generation. The autumn population of the Ichneumonid is dependent on the frequency during the summer of alternate hosts.

JANCKE (O.) & NIETZKE (G.). ***Ceutorrhynchus suturalis* Fabr., ein wenig bekannter Zwiebelschädling.** [*Ceuthorrhynchus suturalis*, a little-known Pest of Onions.]—*Z. angew. Ent.* **26** pt. 2 pp. 209–214, 7 figs., 5 refs. Berlin, 1939.

Brief descriptions are given of all stages of *Ceuthorrhynchus suturalis*, F., and its distribution is summarised from the literature. It attacks

onion and occurs throughout Germany, but is nowhere very numerous. It is not known whether it has more than one generation a year.

In the Rhine Palatinate, the overwintered adults were found on onion plants from early May to mid-June and oviposited in the hollow stalks, about 75 per cent. of the eggs being laid in the topmost quarter. About 3 weeks after the date of oviposition, the larvae left the stalks and pupated in the ground. At room temperature, larvae that entered soil on 30th June gave rise to adults on 30th July. The larvae feed on the inner walls of the stalks, producing discoloured patches of irregular shape. Considerable injury is caused to young plants, but older ones generally recover from light infestations. The females also feed on the stalks before ovipositing, and cause discoloration, but not permanent injury [*cf. R.A.E.*, A **25** 209].

SCHWERDTFEGER (F.). **Untersuchungen über die Wanderungen des Maikäfer-Engerlings** (*Melolontha melolontha* **L. and** *M. hippocastani* **F.).** [Investigations on the Movements of the Larvae of Cockchafers.]—*Z. angew. Ent.* **26** pt. 2 pp. 215–252, 9 figs., 26 refs. Berlin, 1939.

A detailed account is given of a variety of field and laboratory observations in Germany on the movement in the soil of larvae of *Melolontha melolontha*, L., and *M. hippocastani*, F., and the factors that influence it. A summary of the information was included in a previous paper and has already been noticed [*cf. R.A.E.*, A **27** 606].

OBOUSSIER (H.). **Beiträge zur Biologie und Anatomie der Wohnungsmilben.** [Contributions to the Biology and Anatomy of Mites infesting Houses.]—*Z. angew. Ent.* **26** pt. 2 pp. 253–296, 20 figs., 62 refs. Berlin, 1939.

In Hamburg, four Tyroglyphid mites, *Carpoglyphus lactis*, L., *Glycyphagus domesticus*, DeG., *G. cadaverum*, Schrank, and *Tyrophagus putrescentiae*, Schr. (*dimidiatus*, Herm.), have proved very troublesome in houses, in which they occurred in great numbers though they caused little or no damage. *C. lactis* shows a marked preference for figs, dried fruit, jams, and similar products, and is only found near them, but *T. putrescentiae* spreads throughout the house from farinaceous products and can also be introduced in furniture stuffing, such as hay.

The anatomy of all stages of the mites, including that of the hypopi, is discussed at some length, and observations on their bionomics, are recorded from laboratory cultures. All four mites were favoured by moisture, and *T. putrescentiae*, which is typical of the group, bred rapidly at 98 per cent. relative humidity. The mites were less active at 75 per cent. and most of them died within 24 hours at 54.

C. lactis increases rapidly, and can infest large quantities of food products in a short time. The infestation of new goods is mainly due to the protonymphs and tritonymphs, which wander actively. The mites feed on the sugary moisture covering figs and on minute particles that they tear off, but even after several months only slight traces of feeding are visible. The growth of moulds on infested figs is apparently prevented by a secretion from the salivary glands. Adults paired soon after emergence and oviposition occurred 2–3 days later; the two processes are described. The total numbers of eggs deposited varied greatly and averaged about 25–30. Adults lived for

about 40–50 days, the maximum being 93 days for males and 84 for females. The duration of development from egg to adult varied widely for individuals kept under similar conditions, and ranged up to 39 days. Hypopi occurred very rarely, and their formation could not be induced by lowering the humidity or starving the protonymphs.

G. domesticus and *G. cadaverum* are probably the species most frequently found in dwellings. They feed exclusively on moulds and other fungus spores, such as those that are present on hay, and cause no actual damage. Observations are recorded on the infestation by them of hay mattresses. *T. putrescentiae* bred rapidly in flour, figs, dried fruit, nuts, potatoes, moulds and other fungi.

The Tyroglyphids were attacked by predacious mites, including *Cheyletus eruditus*, Schr., and *Cheletomorpha venustissima*, Koch.

MÜLLER (F. P.). **Sterblichkeit und Wachstum der Kieferspannerraupe bei Futter aus Reinbeständen und aus Mischwald.** [The Mortality and Growth of Larvae of the Pine Geometrid fed on Pine Needles from pure Stands and from mixed Forests.]—*Z. angew. Ent.* **26** pt. 2 pp. 359–367, 2 figs., 15 refs. Berlin, 1939.

The experiment described was carried out in Mecklenburg to determine whether the protection against *Bupalus piniarius*, L., that is afforded by planting pines in mixed stands is the result of nutritional or climatic factors. It showed that the larvae developed as well on pine needles from mixed stands as on those from pure stands, and, as they were successfully reared in a shelter in a mixed forest, it indicated that the local climate was not unfavourable.

KAUFMANN (O.). **Der Luzerneblattnager** (*Phytonomus variabilis* **Herbst**). [The Lucerne Weevil, *Hypera variabilis*, Hbst.] **Teile I–II.**—*Z. angew. Ent.* **26** pts. 2–3 pp. 312–358, 387–448, 29 figs., 6 pp. refs. Berlin, 1939.

Although *Hypera* (*Phytonomus*) *variabilis*, Hbst., has attracted considerable attention as a pest of lucerne in the United States, little has been published on it in Europe, where it is indigenous. In Germany, lucerne is being increasingly grown, and a local outbreak of the weevil in Schleswig-Holstein in 1936 led to the investigations described in this paper, which were continued in 1937 and 1938, when injury occurred in many parts of Germany. The data are discussed under the headings of morphology, life-history, epidemiology, parasites and predators, and control, and are compared with those recorded from America and elsewhere.

The following is based on the author's summary: The weevil has one generation a year in Germany [*cf. R.A.E.*, A **22** 3]. The durations at various temperatures of the four larval instars and the egg, prepupal and pupal stages are shown in graphs. The young adults remain for a brief period in the pupal web and appear in July and August. The injury caused by the adults is described, and a list, based on the literature and the author's observations, is given of the plants they attack. The most important of these in Germany are lucerne and vetch (*Vicia sativa*). Some adults hibernate in the lucerne fields and others do so in hedges, etc., to which they begin migrating in summer. They return when temperatures of 8–10°C. [46·4–50°F.] are reached in spring, and oviposition then takes place. Males and

females occur in equal numbers. The numbers of eggs deposited by females averaged 600–700 and reached a maximum of 1,525. Oviposition is at its peak in May, and larval feeding is most intense in June. The relation of the development of the weevil to that of the food-plant is discussed in detail.

Records show that in Germany the first outbreak occurred in 1922, and that serious injury has been caused since about 1928. Agricultural measures are the most important of the factors limiting the abundance of the weevil, followed by natural enemies, while the distribution of food-plants is of secondary importance, lucerne being cultivated over a much larger area than that in which it is infested. The direct and indirect influence of moisture is considered to be of no great importance, though most stages, and especially the eggs, are favoured by high atmospheric humidity. The influence of temperature is considerable, since on it depend whether oviposition and feeding occur under favourable conditions, and it also determines indirectly the degree of control given by cultural measures, especially mowing and harvesting. Reproduction occurs only between about 10 and 25°C. [50 and 77°F.], and the geographical distribution of the weevil lies mainly between the annual isotherms of 5 and 20°C. [41 and 68°F.]. The possibility of forecasting outbreaks is discussed. In Germany, they are to be expected in years in which the weather turns suddenly warm and dry in spring and remains warm through the summer, and will be serious if several such years occur in succession. A list is given of the parasites and predators of the weevil, based on the literature and the author's observations. The most important in Schleswig-Holstein were the Ichneumonids, *Bathyplectes curculionis*, Thoms., and *Pimpla maculator*, F., and the Eulophid, *Tetrastichus incertus*, Ratz.

Control measures are discussed at some length from the literature. In Germany the usual agricultural practices are generally sufficient to check the weevil. Fields should not be kept under lucerne for more than 4–6 years, the soil should be aerated every year by harrowing and hoeing, and weeds should be cleared. One or two weeks before the normal time of mowing, the plants should be examined for signs of infestation. If the leaves are perforated and young larvae fall out when the shoot tips are beaten, the crop should be cut without delay, and the hay should not be left in the field to dry. As a rule it is the first crop that is most threatened in Germany, but oviposition and larval feeding may sometimes be delayed so that the second crop is the one endangered. It is only in exceptional cases that an arsenical insecticide need be applied.

SCHIMITSCHEK (E.). **Beiträge zur Forstentomologie der Türkei II. Ueber einige Schädlinge der Haselkulturen.** [Contributions to the Forest Entomology of Turkey. II. Some Pests of Hazel Crops.]—*Z. angew. Ent.* **26** pt. 3 pp. 449–461, 8 figs. Berlin, 1939.

Details are given of the cultivation of hazel-nuts (*Corylus avellana*) on the eastern Black Sea coast of Turkey, where they are by far the most important crop. In order to avoid the disadvantages of monoculture, the interplanting of fruit trees is suggested; but if apples were grown they would have to be varieties resistant to *Eriosoma lanigerum*, Hsm., which is a serious pest in this region. A list is given of the pests of hazel, based on observations in 1938.

Eriophyes avellanae, Nal., which deforms the buds, was present in all the plantations visited and was the most serious pest. A large number of dead buds results in the death of the twigs and branches, and even of the entire bush. To control this mite, infested twigs and branches should be cut off and burned in autumn, hazel should be planted in good, deep soil, and all patches of thicket extending into the plantation should be cleared. In some places, slight infestation of the roots by larvae of *Melolontha* sp. reduced the crop, and heavy ones killed the bushes. *Curculio* (*Balaninus*) *nucum*, L., and *C.* (*B.*) *glandium*, Marsh., are found in an average of 8–10 per cent. of the nuts, but up to 50 per cent. may be attacked in sunny situations. The nuts are usually picked early and are not shelled until the autumn. The larvae should be prevented from entering the soil after leaving the nuts by storing the latter on a concrete floor, and should be destroyed as they emerge. It is suggested that fumigation chambers should be constructed in the more important centres, and that the nuts should be fumigated immediately after picking.

The bark-beetle, *Xyleborus* (*Anisandrus*) *dispar*, F., is abundant in bushes that are weakened owing to infestation by *E. avellanae* or *Melolontha*, and in bushes growing in dry, stony, sunny areas. In no case were strong, vigorous plants attacked by it. *Lymantria dispar*, L., which sometimes causes serious injury, defoliated hazel over about 12 acres in 1938. The eggs are laid not only on the stems of hazel, but also on rocks and stones.

RIGGERT (E.). **Untersuchungen über die Rübenblattwespe** *Athalia colibri* **Christ** (*A. spinarum* **F.**). [Investigations on *Athalia rosae*, L.]—*Z. angew. Ent.* **26** pt. 3 pp. 462–516, 19 figs., 24 refs. Berlin, 1939.

Athalia rosae, L. (*colibri*, Christ) has been known in Schleswig-Holstein for over 30 years as a pest of swedes, cabbages, rape and mustard. Attacks in 1935 [*cf. R.A.E.*, A **22** 130] and 1936 gave rise to the investigations on its bionomics recorded in detail in this paper, which also includes notes on its distribution and descriptions of all stages.

The following is taken from the author's summary: *A. rosae* usually has 2 generations a year in Schleswig-Holstein. Females predominated, but the males fly actively and can pair more than once. Eggs laid by unfertilised females give rise to males only. For egg maturation the female feeds in blossoms. The eggs were laid on wild and cultivated crucifers, and were deposited singly at the edge of the leaf between the parenchyma and epidermis of the lower surface. They hatched in 4–7 days in the field, and 4–12 in the laboratory, depending on temperature. The newly hatched larvae feed on the lower surface of the leaves, but towards the end of the feeding period they migrate to the upper surface and feed at the edges. After the fifth moult they spin cocoons in the soil and enter the eonymphal stage, in which they overwinter. In spring they develop to the pronymphal stage and then pupate, the actual pupal stage lasting about 4–8 days. Development was in a few cases delayed in the cocoon stage so that the adults emerged about 20 months after the cocoons were formed. The larvae are always present in numbers and damage the leaves of the plants in the same way as does *Pieris brassicae*, L.

Parasites bred from *A. rosae* comprised the Tachinids, *Tachina rustica*, Mg., and *Meigenia mutabilis*, Fall., the Ichneumonids, *Mesoleius ciliatus*, Hlmgr., *Perilissus lutescens*, Hlmgr., *Acanthocryptus flagitator*, Grav. and *Anilastus* sp., the Perilampid, *Perilampus italicus*, F., and the Nematode, *Mermis albicans*, but their economic importance was slight. Arsenical insecticides give good control, but dusts of derris or pyrethrum are preferable for vegetables or fodder plants. In field tests, two proprietary dusts combining derris and pyrethrum gave 99·5 and 95·5 per cent. mortality of the larvae and were superior to two others containing pyrethrum but not derris.

Bogoescu (C.). *Myrmecocystus cursor* **Fonsc. şi** *Myrmecocystus viaticus* **Fab. (Formicidae) doi auxiliar noui ai omului în agricultură.** [*M. cursor* and *M. viaticus*, two new Assistants of Man in Agriculture.]—*Bul. Soc. Nat. Român.* no. 12 pp. 6–11. Bucharest, 1938. [Recd. 1939.]

The value of predatory insects in the control of insect pests is briefly discussed, and notes are given on the habits of the predacious ants, *Cataglyphis* (*Myrmecocystus*) *cursor*, Boy., which occurs in south-western Rumania, and *C.* (*M.*) *viaticus*, F., which is found in eastern districts. They do not build nests, but live in galleries made in sandy and arid soil in places well exposed to the sun, and their presence can be detected by the small heaps of food débris that they remove from the galleries and place near the entrance holes. An analysis of the contents of heaps accumulated by *C. viaticus* showed that the diet consisted exclusively of insects. These included grasshoppers, Pentatomids, beetles, wasps and larvae of sawflies and Lepidoptera, all of which are or may be injurious, as well as *Messor barbarus*, L., an ant that has been recorded in eastern Rumania as feeding on the unripe seeds of cereals, and in the autumn and spring on the stems.

Fintescu (I.). **Evoluţia larvei** *Liparis chrysorrhoea* **Dup.** [The Development of the Larva of *Nygmia phaeorrhoea*, Don.]—*Bul. Soc. Nat. Român.* no. 12 pp. 18–21. Bucharest, 1938. [Recd. 1939.]

Detailed descriptions are given of the five larval instars of *Nygmia phaeorrhoea*, Don. (*Liparis chrysorrhoea*, auct.), with brief notes on the habits of the larvae as observed in 1920 on apple and pear in north-eastern Rumania. Oviposition occurred during the first week of July, and the eggs hatched 16–20 days later. The young larvae are gregarious and feed on the upper epidermis and mesophyll of the leaves, leaving the lower cuticle and the veins intact; the leaves are covered with a thin web and are joined together to form nests in which the larvae shelter at night. Larvae of the second instar hibernate in the nests and resume activity in the spring. In 1920, they began to abandon the winter nests on 4th April and fed on young buds. Larvae in the fourth and fifth instars fed singly on the lower surface of the leaves and were considerably less active than the younger ones. Pupation began on 3rd June.

Fintescu (I.). **Un purece de plante sau Aphid pe păr în grădina mea *Dentatus piri* Koch.** [A Plant Louse or Aphid on Pear in my Orchard.]—*Bul. Soc. Nat. Român.* no. 12 pp. 21–24, 3 figs. Bucharest, 1938. [Recd. 1939.]

An instance is recorded of a severe infestation of pear trees in the town of Jassy in June 1936 by *Anuraphis farfarae*, Koch (*Dentatus pyri*, Koch), which covered the leaves with honey-dew and caused curling and deformation. The infested twigs were not able to sustain the fruits, which eventually dropped. All the adult Aphids found in the colonies were apterous viviparous females, a description of which is given.

Briggs (C. H.). **A Bibliography of Cerealiana.**—Demy 8vo, 59 pp. Minneapolis, Minn., The Miller Publ. Co., 1938. Price 50 *cts.* [Recd. 1940.]

This is a bibliography of books and pamphlets on cereal production and marketing, milling and baking, and infestation by insects and fungi of cereals in the field and stored cereals and cereal products. The publications are arranged in two groups, the first consisting of books and pamphlets listed alphabetically under authors' names, and the second of publications of official agricultural institutions.

Stanley (J.). **Time required for the Development of *Tribolium* Eggs at 27°C.**—*Ann. ent. Soc. Amer.* **32** no. 3 pp. 564–569, 2 figs., 3 refs. Columbus, Ohio, 1939.

An apparatus is described by means of which the time required for the development from oviposition to hatching of the eggs of *Tribolium confusum*, Duv., can be determined mechanically for large numbers of eggs. The data obtained with it at 27°C. [80·6°F.] and 75 per cent. relative humidity are shown in tables. The mean incubation period was found to be 149·21 hours, with a standard deviation of 4·55 hours.

Crandell (H. A.). **The Biology of *Pachycrepoideus dubius* Ashmead (Hymenoptera), a Pteromalid Parasite of *Piophila casei* Linne (Diptera).**—*Ann. ent. Soc. Amer.* **32** no. 3 pp. 632–654, 15 figs., 9 refs. Columbus, Ohio, 1939.

The Pteromalid, *Pachycrepoideus dubius*, Ashm., has been recorded from Argentina, Australia, the Philippine Islands, India, Canada and the United States and has been established in the Hawaiian Islands [*cf. R.A.E.*, A **7** 149]. From the available evidence, the author considers it probable that it could parasitise any members of the Cyclorrhapha in which the pupal stage is spent within the hardened exuvium of the last larval instar, but that it will never attain economic importance in the control of its hosts in the field.

An account is given of biological investigations made during 1935–37 in Ohio on *P. dubius* as a parasite of *Piophila casei*, L. [*cf.* **15** 325]. The technique is described, and the various stages, including the five larval instars, are described in detail. The host was reared on smoked ham, and its life-cycle averaged 18 days. The egg, larval, prepupal and pupal stages of the parasite lasted 12–20 hours, 8–10 days, 24–36 hours and 6–9 days, respectively. The pupal stage of the male was

shorter than that of the female. The length of adult life varied considerably, but averaged 18·3 days for males and 17·6 for females kept in separate vials and provided only with moistened raisins. Pairing may occur immediately after the emergence of the female from the host and oviposition may begin within an hour of emergence and continue intermittently until within one or two days of death. The ratio of males to females was 2 : 3. Females that remained unfertilised for 5 days produced male offspring parthenogenetically. Eggs are deposited singly on the host pupae in the puparium or on prepupae in the puparium if pupae are not available. A female may oviposit more than once on a single host. In one instance, the chorions of 26 eggs were found in a single puparium, but only one individual normally develops in each puparium, as a newly hatched larva destroys any eggs or other larvae that it finds. On certain of its hosts in the laboratory, *P. dubius* proved a weak competitor of *Muscidifurax raptor*, Gir. & Sand., another external parasite of Dipterous pupae ; its intrinsic superiority over other Hymenopterous parasites of *Ceratitis capitata*, Wied., in Hawaii [**7** 149] is probably due to the fact that these are internal parasites. There is only one record of *P. dubius* as a true hyperparasite [**18** 677], and it is not known to have any primary parasites.

Cox (J. A.). **A preliminary Report on the Woolly Aphids of Apple and Hawthorn.**—*J. econ. Ent.* **32** no. 4 pp. 477–483, 7 figs., 5 refs. Menasha, Wis., 1939.

Some of the literature on the relation between *Eriosoma crataegi*, Oestl., and *E. lanigerum*, Hsm. [*R.A.E.*, A **3** 421 ; **6** 311 ; **20** 16] is reviewed [*cf.* also **26** 484]. Hawthorn (*Crataegus*) in south-western Virginia is usually heavily infested with *E. crataegi*, which congregates on the lower side of the twigs and branches, but it has never been found on the roots, nor has feeding on the twigs and branches been observed to stimulate the formation of galls. In view of the difficulty of obtaining enough Aphids from apple for studies on the resistance of apples, experiments were begun in 1936 to determine whether the woolly aphis found on hawthorn was the same as that found on apple. The young of spring migrants of *E. lanigerum* from rosettes on *Ulmus americana* [but *cf.* **26** 484-485] established themselves readily on apple and wild crab apple, but became established on only 1 hawthorn tree out of 36. This agrees closely with the low rate of natural infestation of hawthorn by the woolly apple aphis. Apterous viviparous females of *E. lanigerum* from apple, hawthorn and crab established themselves on either food-plant, but much less readily on hawthorn than on the other two. Apterous viviparous females of *E. crataegi* from hawthorn transferred to apple, crab and hawthorn became established on hawthorn only. *Aphelinus mali*, Hald., was not reared from *E. crataegi* in field collections and would not attack this species under cage conditions in the field or in the insectary. The location of infestations of *E. lanigerum* on hawthorn was often facilitated by the observation of parasitised individuals. Morphological studies showed that the segments of the antennae of the spring and autumn migrants of *E. crataegi* are longer and have more annulations than those of migrants of *E. lanigerum* (collected on apple), and the antennae of the apterous viviparous females of *E. crataegi* are longer than those of apterous viviparous females of *E. lanigerum*.

The cells of the wax pores of *E. crataegi* are smaller and have a thicker surrounding wall than those of *E. lanigerum*. A study of individuals of *E. lanigerum* from apple and hawthorn indicated that the food-plant does not affect the length and structure of the antennae or the structure of the wax pores. The woolly filament of *E. crataegi* is granular, compact and chalky white, whereas that of *E. lanigerum* is in long, silken, fluffy threads and is sometimes bluish-white in colour. The alternate food-plant of *E. crataegi* was not found.

SANDERSON (M. W.). **Crop Replacement in Relation to Grasshopper Abundance.**—*J. econ. Ent.* **32** no. 4 pp. 484–486. Menasha, Wis., 1939.

In 1936, grasshoppers, particularly *Melanoplus differentialis*, Thos., became of major importance in Arkansas, especially the north-eastern counties, for the first time [*R.A.E.*, A **27** 178]. Since 1933, the area devoted to cotton in this region has been reduced by about 9 per cent., and of the land thus freed, about 62 per cent. has been given over to soy beans. Pasture land has also been increased. This is a preliminary report on an investigation made to determine, under controlled conditions, the relative values of cotton and soy beans as food-plants for *M. differentialis*. Bermuda grass [*Cynodon dactylon*], the most important pasture grass in the region, and wheat were also included for comparison. The grasshoppers fed readily on both wheat and soy beans, and many reached maturity. Occasionally the young nymphs did not respond so readily to wheat as to soy bean. Very few nymphs fed exclusively on cotton reached maturity, and mortality was particularly high in the early instars. All hoppers caged with Bermuda grass died before reaching the second instar without having made any apparent attempt to feed. The mean nymphal periods on soy bean, wheat and cotton were 69·00, 65·13 and 102·37 days. The mean periods of adult life for females reared on soy bean and wheat were 47·14, and 38·80 days, and for individuals reared on cotton, 100 days. The average numbers of egg pods laid by females reared on soy beans and wheat were 2·59 and 1·8, respectively, and the average numbers of eggs, 304·6 and 208·6. The only female reared on cotton that oviposited laid one pod containing 73 eggs.

SNAPP (O. I.). **Dichloroethyl Ether for the Control of the Plum Curculio attacking Peaches.**—*J. econ. Ent.* **32** no. 4 pp. 486–490, 2 figs. Menasha, Wis., 1939.

Preliminary laboratory and orchard experiments were carried out in Georgia in 1937 and 1938 on the possibility of applying dichloroethyl ether in water as a spray to the soil under peach trees for the control of *Conotrachelus nenuphar*, Hbst., and so avoiding the use of an insecticide on the fruit. The properties of dichloroethyl ether are given, and the laboratory equipment is described. The sprays contained $\frac{1}{3}$, $\frac{2}{3}$ or 1 fl. oz. dichloroethyl ether per U.S. gal., and all were applied at the rate of 1 U.S. gal. per sq. yard. In the laboratory, $\frac{1}{3}$ fl. oz. killed all larvae in 1937 and 98·9 per cent. in 1938, 1 fl. oz. killed 89·4 per cent. of the pupae in 1937, and $\frac{2}{3}$ fl. oz. killed all pupae in 1938. In 1938, the soil under two caged trees was treated with sprays containing 1 fl. oz. dichloroethyl ether against 1,000 pupae and $\frac{1}{3}$ fl. oz. against 1,000 larvae, respectively. No adults emerged in the first cage and

only 9 in the second. Most of the larvae died 5–16 days after treatment, and pupae began to die 3 days after treatment. All the peaches produced on the two trees were free from larvae. Of the 9 adults that emerged, 3 died before the peaches began to ripen, and all may have been sufficiently affected by treatment to have been prevented from ovipositing. No injury to the roots from the dichloroethyl ether could be discerned. The cost of treatment, which is considerably higher per application than that of lead arsenate and lime [*R.A.E.*, A **23** 694], is discussed. One application per season might suffice, but it is thought that one against the larvae and one against the pupae might be required.

CARTER (R. H.). **Significant Properties of some Cryolite Materials offered for Insecticidal Use.**—*J. econ. Ent.* **32** no. 4 pp. 490–492. Menasha, Wis., 1939.

The fluorine contents of 12 synthetic cryolites (made in the United States or imported), 2 natural cryolites and 4 diluted powders were determined, and the equivalent content of sodium fluoaluminate calculated. Their solubility and moisture content, and the particle size distribution of two samples of synthetic cryolite were also determined. The methods of analysis used for determining fluorine and solubility are briefly described. Solubility was also determined by evaporation and weighing of residues. The different types of materials contained different amounts of fluorine, but there was agreement between the samples in each class. Samples of domestic synthetic, foreign synthetic and natural origin had average sodium fluoaluminate contents of 82·8, 91·3 and 88·2 per cent., respectively. The results of the two methods of determining solubility were in agreement. The solubilities of the diluted powders and of a sample composed of large particles were considerably lower and those of natural products slightly lower than those of the undiluted synthetic cryolites.

It should be emphasised that, for insecticidal use on field crops, cryolite products should contain very little, if any, material that is more soluble than cryolite itself. From these determinations, it appears that the solubility figure should not exceed approximately 0·028 gm. fluorine per 100 cc. at 23–25°C. [73·4–77°F.], which is equivalent to 0·053 gm. sodium fluoaluminate. This is in close agreement with the solubility figure for this material given in chemical handbooks. Likewise, a decrease in the insecticidal efficiency may be expected when the solubility is reduced by diluents or large particles.

WALKER (H. G.) & ANDERSON (L. D.). **Desilking Sweet Corn to control Corn Ear Worms, and notes on Control of Fall Armyworms.**—*J. econ. Ent.* **32** no. 4 pp. 492–495, 1 fig., 4 refs. Menasha, Wis., 1939.

The removal of the silk for the control of *Heliothis armigera*, Hb. (*obsoleta*, F.) was tested on sweet maize planted in April and May in Virginia in 1938. Sweet maize planted in July was so severely injured by *Laphygma frugiperda*, S. & A., that it could not be used in the experiment. A suspension of lead arsenate (2 lb. in 50 U.S. gals. water), applied as a spray or by pouring it on the plants so that it ran down into the growing tips and round the leaf sheaths, gave promising results for the control of *L. frugiperda*, and poison bran mash sprinkled

on the plants killed many of the larvae but injured the foliage. Cutting off the silks and a small portion of the tips of the husks and removing them from the field was almost as effective against *H. armigera* at intervals of 5 days as at intervals of 3. At both, it increased the number of uninfested and marketable ears in all tests, and the increase was significant in 4 tests out of 7. It is doubtful whether the increased yield would repay the cost of treatment on a large commercial scale, but on a small scale or where labour is cheap it might be profitably used. The effect on pollination appeared to be too slight to be of any consequence.

DOMINICK (C. B.). **Notes on the Tobacco Flea Beetle, *Epitrix parvula* (F.).**—*J. econ. Ent.* **32** no. 4 pp. 495–498, 2 figs., 2 refs. Menasha, Wis., 1939.

A study of *Epitrix parvula*, F., was made in Virginia in 1937 and 1938. Examination of tobacco fields in the south of the State on the approach of cold weather in 1937 showed that hibernation occurred principally under leaves and other débris at the edge of woods adjoining the fields in which the flea-beetles had been numerous during the summer. Some adults were also found under litter on the ground in the fields. The methods of obtaining data on the abundance of the beetles are outlined. In 1938, they were first noted in the field on 19th March and were obtained from litter collected as late as 28th May. By this time, first-generation adults had appeared in the field. Emergence from hibernation began earliest in areas exposed to the direct rays of the sun during most of the day. There was a great difference in the number of beetles taken from various positions in the same woods, the largest numbers occurring in well-drained areas. Beetles were found in hibernation on 21st September, but a few were still feeding sparingly on tobacco on 1st November. The methods used in studying the life-history in the laboratory are described. Four generations were reared during 1938. Adults that had just emerged from hibernation were caged in the insectary on 22nd March and began to oviposit on 5th April. Adults of the first three generations began to emerge and to oviposit on 2nd and 10th June, 12th and 19th July, and 15th and 24th August, respectively. The fourth-generation adults began to emerge on 9th October, but laid no eggs. The average durations in days of the egg, larval and pupal stages were 10·52, 28·09 and 7·73, respectively, in the first generation, 7·06, 18·24 and 5·94 in the second, 6·65, 18·41 and 7·2 in the third, and 8·28, 31·5 and 13·46 in the fourth.

WALKER (H. G.) & ANDERSON (L. D.). **Control of Truck Crop Aphids.**—*J. econ. Ent.* **32** no. 4 pp. 498–505, 3 refs. Menasha, Wis., 1939.

The methods used against three species of Aphids infesting vegetable crops in Tidewater, Virginia, and the results of experiments carried out on their control are summarised. As a limited number of plants are often attacked by *Brevicoryne brassicae*, L., before infestation becomes general in a field of cruciferous crops, severe damage can often be prevented by treating these plants thoroughly with a 3 per cent. nicotine dust or removing them from the field and destroying them. Dusting kale and cabbage plants with 3 per cent. nicotine dust applied at the rate of 35–45 lb. per acre from a duster having a 45-ft. muslin trailer gives good control. In November 1938, a 3 per cent. nicotine

dust applied at 40–50 lb. per acre from a duster having a 50-ft. trailer and moving at 4–5 miles an hour, and vaporised nicotine at 3½ lb. per acre from a vaporiser having a 100-ft. gas-tight apron and moving 100 ft. per minute, both gave very good control of *B. brassicae* on the leaves of green sprouting broccoli, but both failed to kill all the Aphids in protected positions in the heads, though the vaporised nicotine appeared to be slightly better in this respect. There was little, if any, difference between the effectiveness of 4¼ and 5 lb. vaporised nicotine per acre, but both seemed to give somewhat better kills in the heads than 3½ lb. Dipping young cabbage plants in a solution containing 1 U.S. gal. 40 per cent. nicotine sulphate, 2½ U.S. gals. Red "A" Soap [*R.A.E.*, A **27** 530] and 500 U.S. gals. water at a temperature of about 65°F., gave good control of *B. brassicae* in March 1937. The quantity was sufficient to treat about 100,000 plants. Poor plants appeared to be slightly injured by this treatment, although healthy plants have been dipped in even stronger solutions without apparent injury [**23** 603].

Vaporised nicotine at 3 lb. Vapo-fume Liquid (80 per cent. free nicotine) per acre and 3 per cent. nicotine dust at 40–50 lb. per acre were about equally effective against *Myzus persicae*, Sulz., on spinach. In 1938, nicotine vapours gave about 86 per cent. control when applied through a circulator having a fan that forced the vapour down through the plants and about 77 per cent. when applied through distributor pipes. Dipping cut spinach in a dilute mixture of pyrethrum and neutral soap was effective in killing *M. persicae*, and the Aphids could then be removed in the process of washing before packing the spinach for market.

Extensive tests on the control of *Macrosiphum onobrychis*, Boy. (*Illinoia pisi*, Kalt.) on peas were carried out in 1937 and 1938. Vaporised nicotine at 3 lb. Vapo-fume Liquid per acre applied while the plants were dry gave the most satisfactory control under field conditions. Derris and cubé sprays in combination with suitable wetting and spreading agents gave good control in experimental tests, but failed to do so in some field trials. A spray containing derris extract in oil (Santex R [**27** 530]) gave very promising results in comparison with sprays containing cubé powder. In general, derris and cubé did not give as good control when used as dusts as when used as sprays.

JONES (E. T.). **Grasses of the Tribe Hordeae as Hosts of the Hessian Fly.**—*J. econ. Ent.* **32** no. 4 pp. 505–510, 2 figs., 6 refs. Menasha, Wis., 1939.

It has been shown that *Mayetiola* (*Phytophaga*) *destructor*, Say, can develop on grasses other than cereals in the United States [*R.A.E.*, A **19** 494; **25** 25; **26** 728]. Examination of field samples and evidence obtained from pot and plot tests during the years 1927–38 showed that it was able to develop on many species of grasses of the tribe Hordeae, but did not become established on grasses of other tribes, with the exception, in rare cases, of species of *Bromus*, on which a few small, distorted puparia were produced. There was not always a relation between the attractiveness of a species for oviposition and its ability to support development. Differences were observed in the reaction to infestation of the genera, species and even strains tested. In general, species of *Lolium* were resistant, and species of *Agropyrum* and *Elymus* susceptible. In addition, *Hystrix californica*,

Sitanion hystrix and *Triticum aegilopoides boeoticum* were susceptible, and *A. pungens* and *Haynaldia villosa* resistant. There appeared in many cases to be a correlation between the character of the tissue of the leaf-sheath and susceptibility to infestation. In general, plants with soft tissues produced the largest numbers of puparia. Infestations on some grasses differed from the characteristic infestation on wheat [**24** 254] in that the outer sheaths were destroyed and the central part uninjured. Larval development was slower on most of the grasses than on susceptible wheat.

LATHROP (F. H.). **Ten Years of Warfare against the Blueberry Maggot.** —*J. econ. Ent.* **32** no. 4 pp. 510–513, 2 figs., 1 ref. Menasha, Wis., 1939.

Rhagoletis pomonella, Walsh, became of major importance as a pest of blueberries in eastern Maine in 1924 [*R.A.E.*, A **12** 7]. Following experiments on its control, calcium arsenate dust was recommended [**18** 645]. The results of the practical application of this measure are reviewed from the records of a canning factory for the years 1927–37. They are measured in terms of the number of larvae in a unit quantity (20 oz.) of fresh, raw berries. Approximately 260,000 bushels of fruit from a large portion of Washington county were examined in the 11 years. The percentage of heavily infested units decreased steadily over the period and that of slightly infested and uninfested units increased, though with fluctuations in which economic factors were sometimes involved. Larger areas were dusted each year until 1930, when the treated area reached nearly its maximum. A considerable increase in the proportion of uninfested berries began in 1935. This is attributed to the increase in the areas dusted, favourable weather, the cumulative effects of dusting large areas for a considerable period, and an increasing tendency to make three applications. Further investigations on injury to the plants, on rotenone-containing insecticides [**26** 333] and on the effect of applying calcium arsenate on the abundance of bees and other beneficial insects are recommended.

BATCHELDER (C. H.). **Experiments with Quebracho-fixed Nicotine for the Control of the European Corn Borer.**—*J. econ. Ent.* **32** no. 4 pp. 513–516, 1 fig., 2 refs. Menasha, Wis., 1939.

Field-plot experiments carried out in Connecticut in 1937 with quebracho-fixed nicotine for the control of *Pyrausta nubilalis*, Hb., on sweet maize indicated that this material possesses insecticidal properties comparable with those of powdered derris root. The substance with which nicotine is combined, an extract derived from quebracho wood [*Quebrachia*], gives certain highly desirable physical properties. The fixed nicotine can be prepared in stable concentrated form for storage, a wetting and spreading agent is present in the extract, and the sprays when mixed for field use are convenient to handle. The derris spray contained 0·0235 per cent. rotenone and the quebracho-fixed nicotine spray 0·0625 per cent. nicotine. The concentrate was prepared by mixing a 50 per cent. solution of nicotine with quebracho extract at the rate of 1 : 13 by weight and keeping the mixture in a closed container for 2 hours at 65°C. [149°F.]. It consisted of 4·35 per cent. nicotine and about 26 per cent. quebracho tannins, 27 per cent. nontannin compounds derived from the woody

tissues of the quebracho, 15 per cent. of the solvent and 27·65 per cent. water. When required, it was diluted with water at 1 : 100 by weight. At this concentration, about 26 per cent. of the nicotine was water-insoluble. The derris and quebracho-fixed nicotine reduced the number of borers in the plants by 82·2 and 67·9 per cent., respectively, and in the ears by 80·6 and 81·0 per cent. [*cf. R.A.E.*, A **25** 769].

Clark (C. A.). **Host Plants and Seasonal Development of the European Corn Borer in New Jersey.**—*J. econ. Ent.* **32** no. 4 pp. 516–520, 1 fig. Menasha, Wis., 1939.

The following is based on the author's summary: Maize is the preferred food-plant of *Pyrausta nubilalis*, Hb., in New Jersey. In the central part of the State in 1938, the first generation was present from the end of May until late July and the second generation after the middle of July. A small percentage of this gave rise to a third, which appeared late in August. The occurrence of this partial third generation was corroborated in plot and cage work. Early sweet maize was only lightly infested by the first generation in 1938, but both field and sweet maize carried high populations of the second generation, with severe economic damage in many fields. On hundreds of acres, half of the crop of field maize was lost, and in some cases, harvesting was not attempted. Potatoes were heavily infested by first-generation larvae, especially where maize acreages had been reduced or eliminated. Infestation in mid-season potatoes was light. Second-generation larvae were found in dahlias, gladiolus, aster, ragweed (*Ambrosia*), smartweed (*Polygonum*) and string beans. The partial third generation attacked, in addition to late maize, potatoes planted in late July and early August for seed.

Ficht (G. A.) & Hienton (T. E.). **Studies on the Flight of European Corn Borer Moths to Light Traps : A Progress Report.**—*J. econ. Ent.* **32** no. 4 pp. 520–526, 2 figs., 2 refs. Menasha, Wis., 1939.

A report is given of preliminary studies in Indiana in 1935–38 on the effectiveness of light-traps in reducing the population of *Pyrausta nubilalis*, Hb., on maize. Two arrangements were used, one in which the lights were placed at regular intervals round the margins of the area to be protected and the other in which they were placed at regular intervals within the area. The traps were of the electrocutor type and were hung from posts 11ft. high by means of a rope and pulley. The most satisfactory type of lamp tested before 1938 was a 250-watt, 115-volt, Mazda CX, with a special glass bulb that transmits most of the ultraviolet radiation emitted by the tungsten filament and an inside frosted bulb. During 1938, another type of lamp, referred to as an H4, with a wattage of 90 was more effective. The position of the traps with respect to the height and vigour of the maize surrounding them and the distance from maize considerably influenced the number of moths captured.

In 1938, when 10 traps were used in or round areas of $3\frac{1}{2}$ acres and were operated for about a month and 47 days against the overwintered and summer generations, respectively, about 351 moths per trap were caught in the interior of the field and about 155 at the margins. This effect of position was also noted in the experiments of 1935–37. There was also a direct correlation between the height of the maize under the light-traps and the number of moths taken in them, particularly

in the second flight. The selection of the taller maize by the moths is a normal reaction. The numbers of males and females taken were approximately equal in the first flight period, but in the second there was a preponderance of females (70·3 per cent. in 1938). Practically all the females attracted to the light were gravid. The time and duration of flight depended on the weather. Activity continued from dusk to dawn on favourable nights, but maximum flight occurred between 11 p.m. and 2 a.m. Activity decreased rapidly when the temperature dropped below about 60°F. The seasonal periods of operation of the lights varied with the climatic conditions and development of the borer. The development of a summer generation has greatly increased in recent years in Indiana, and this has increased the number of nights on which light-traps need to be operated to provide control. Early or late sweet maize would probably not require lighting throughout both flight periods, and dent maize is frequently nearing maturity before the larvae of the second brood reach full growth. Infestation was distinctly grouped around the lights [*cf. R.A.E.*, A **23** 645]. However, the maize within several feet of the lamps was decidedly taller, greener and less mature than that further away, and so must have attracted ovipositing females. This grouping of infestation made it difficult to estimate the effect of the lights on infestation as a whole. In 1938, the average numbers of first-brood larvae per 100 plants were 0 in the field surrounded by lights, 0 in the other lighted field and 2–23 in 5 control fields in the neighbourhood. If plants within 20 ft. of the lights were disregarded, the corresponding figures for the second brood were 7·9, 6·5 and 21–100·4.

Baker (W. A.) & Questel (D. D.). **Investigations of Insecticides for Control of the European Corn Borer, at Toledo, Ohio, 1937–1938.**— *J. econ. Ent.* **32** no. 4 pp. 526–530. Menasha, Wis., 1939.

Studies of the effectiveness of sprays and dusts containing fixed nicotine preparations, fluorine compounds or derris, and a spray of 4 lb. thiodiphenylamine (phenothiazine) in 100 U.S. gals. water, for the control of *Pyrausta nubilalis*, Hb., on early sweet maize in Ohio were carried out under field-plot conditions during 1937 and 1938. The experimental technique is described. Derris (4 per cent. rotenone) at 4 lb. per 100 U.S. gals, and the fluorine compounds gave a high degree of protection when used as sprays in a standard treatment schedule [*R.A.E.*, A **25** 718]. The fluorine compounds were somewhat improved by the addition of 2 lb. bentonite clay per 100 U.S. gals. However, they caused considerable injury to the plants. Calcium fluosilicate at 2–6 lb. per 100 U.S. gals. gave the best control and was the least injurious of them. The toxicity of cryolite (sodium fluoaluminate) was not noticeably reduced when the concentration was reduced to ½ lb. per 100 U.S. gals., but the injurious effects on the plant remained. Thiodiphenylamine and the nicotine compounds (approximately 0·0625 per cent. nicotine in the spray) failed to give controls comparable with those obtained consistently with the same materials in the New England States [*cf.* **25** 770]. In general, the dusts were much less effective than the sprays. It is thought that the effectiveness of dusts could be increased by modifying the standard schedule and making applications immediately after rain, or increasing the number of applications, or both. The use of dusts would lower costs on account of the ease and rapidity with which they can be applied.

Schlosberg (M.) & Baker (W. A.). **Sweet Corn Resistance to Larval Survival of the European Corn Borer.**—*J. econ. Ent.* **32** no. 4 pp. 530–534, 1 fig., 6 refs. Menasha, Wis., 1939.

Studies of resistance of inbred strains of sweet maize to *Pyrausta nubilalis*, Hb., were begun in Ohio in 1935 and continued in 1936–38. In each year, the maize was uniformly infested with eggs by hand, and the larval populations were determined by dissection of the plants when the larvae were approximately full-grown. No significant difference in larval population was found among the strains tested in 1935, but strain M1828 from Michigan showed marked power of inhibiting larval survival in the three following years. Several other inbred strains, tested in these years, showed a tendency towards resistance, but none to an extent that would preclude the possibility of error. The resistance of M1828 to larval survival at different stages of development was examined in 1938. The inbred strain C2 from Connecticut, which had shown approximately average larval survival in 1936 and 1937, was used for comparison. Each strain was infested at 22 stages of development. These stages in the two strains, expressed as the mean number of days between the date of infestation and the mean date of silking of the plants, the resultant population of mature larvae per plant, and the dates of planting and infestation are shown in a table. There was a high degree of correlation in each strain between the stage at which the plant was infested and the resultant population, low populations being associated with early infestation. Also, in all cases except one, the population on M1828 was lower than the population resulting from infestation on the same date on C2, although the former was more advanced. The comparative survival of larvae in the two strains when these were infested at the same stage of development is shown in a graph. There were great differences between the larval survivals on the two strains, which diminished with the earliness of infestation. The differences were significant when infestation occurred between 5 and 25 days before the appearance of the silk. When it occurred earlier, they were not significant. This has no practical importance, as populations resulting from such early infestation are never high.

Gould (G. E.). **Cucumber Beetle Control Studies in 1937 and 1938.**—*J. econ. Ent.* **32** no. 4 pp. 534–537, 2 refs. Menasha, Wis., 1939.

Studies in Indiana on the control of adults of *Diabrotica melanocephala*, F. (*vittata*, F.), which limit the profitable production of melons and cucumbers by feeding on them and spreading bacterial wilt, were continued in 1937 and 1938 [*cf. R.A.E.*, A **25** 30]. They included experiments in which diluents for dust mixtures were tested alone, as these often affect the effectiveness of the mixtures. Cucumbers for these tests were planted early (in the last week of May), and the dusts were applied at intervals of 4 days (or less if rain fell) from the time that the plants appeared above ground. The diluents with the best physical properties were flour, talc, and hydrated lime. Dusting gypsum was too heavy and Celite too light. Plants dusted with talc produced the longest vines in 4 weeks and were followed by those dusted with hydrated lime, flour and gypsum in that order. Under certain conditions, hydrated lime scorched and stunted the plants. The beetles were abundant and destroyed very many of the

plants, although the presence of the diluents repelled them for a short time.

Cucumbers for the tests of insecticide and fungicide mixtures were planted early in June. The mixtures comprised sprays of calcium arsenate with Bordeaux mixture or copper oxychloride and 15 dusts in which calcium arsenate was usually used as the insecticide, talc, clay and talc or gypsum as the diluent and various copper compounds as fungicides. Applications were made as soon as the plants came up and subsequently at intervals of 3–5 days, or oftener in the case of rain, until about two days before the first picking. Certain treatments, particularly Bordeaux mixture, adversely affected growth. Plants treated with the sprays or with copper arsenate dust showed typical copper yellowing of the leaf edges and in some cases of areas in the leaves. The beetles were common in most plots throughout both seasons, owing largely to migrations from neighbouring gardens, and injury on the control plots began early and increased throughout the season in both years. The percentage of plants dying from wilt, the average length in inches of vines thinned and the yield per acre in number of fruits and number of bushels are shown for each year and each treatment in a table. Effectiveness was judged from these data as the proportion of beetles killed is difficult to estimate. Using the yield (weight) as the unit, the data were analysed statistically. In both years a mixture of 3·25 lb. calcium arsenate, 2 lb. copper oxychloride (metallic copper content 25 per cent.) and 11 lb. talc and one of Alorco cryolite (synthetic sodium fluoaluminate containing 83 per cent. active ingredients) and talc (1 : 4) gave significantly higher yields than the standard 1 : 9 mixture of calcium arsenate and gypsum.

Ditman (L. P.), Cory (E. N.) & Graham (C.). **Studies on Pea Aphid Control.**—*J. econ. Ent.* **32** no. 4 pp. 537–546, 4 figs., 1 ref. Menasha, Wis., 1939.

Detailed records are given of the results obtained in the first year of an experiment begun in 1938 and intended to extend over 5 years to determine whether annual applications of insecticide for the control of *Macrosiphum onobrychis*, Boy. (*Illinoia pisi*, Kalt.) on peas in eastern Maryland would be profitable. Infestation during 1938 was very heavy; it began almost as soon as the peas were out of the ground, and continued until a week before harvest. One control plot that should have yielded 1½ tons shelled peas per acre gave only 154 lb. The treatments compared were two applications of derris plus Aresket (2·6 per cent. rotenone), cubé plus Vatsol OS (3·8 per cent. rotenone), and Agicide (said to contain 1 per cent. rotenone by weight plus a wetting agent and activators), and one late and one early application of the cubé. The derris and cubé mixtures contained 7 parts of the ground root and diluent to 1 part of the wetting agent, and both mixtures were used at the rate of 4 lb. per 100 U.S. gals. water. The Agicide was used at the rate recommended by the manufacturer. The sprays were applied on 2nd and 11th May at about 175 U.S. gals. per acre. The experimental technique is described. Populations were estimated by counting Aphids per tip and by sweeping on all plots; in addition, counts of Aphids on entire plants were made on 5 of the 19 plots. The number of Aphids per sweep and per tip and the percentage infested tips were all satisfactory indices of the degree of

control obtained. However, the counts on sprayed plants indicated that mortality caused by sprays is heaviest on the terminal portions of the plants, and that tip counts and sweeps indicated a greater percentage reduction in population than had actually occurred. Agicide gave a slightly higher kill of Aphids than derris, and derris gave a higher kill than cubé, on the basis of number of Aphids per sweep and per tip and percentage of infested tips. After the second application, there was little difference between the number of Aphids per tip or per sweep on these plots. An application of cubé on 11th May caused a considerably greater reduction in population than one on 2nd, probably because by the later date a larger proportion of the Aphids was on the tips of the plants, where they are more easily hit, but neither application alone gave satisfactory control. The highest yields (about 2,000 lb. per acre) occurred on plots with less than 30 per cent. tips infested, about 2 Aphids or less per tip and about 10 Aphids per sweep. Records of mosaic were taken on all plots on 19th May. There was about 50 per cent. infection on the plots that gave the best yield, while on the control plots nearly all the plants were infected. The increases in yield were corrected to allow for uneven distribution of Aphids over the set of plots, and the corrected yields were examined mathematically. The differences between the yields of plots sprayed with Agicide and cubé, and derris and one application of cubé were found to be significant, but those between the yields of plots sprayed with Agicide and derris, derris and two applications of cubé, and one and two applications of cubé were not. Peas from heavily infested plots were of small size and poor quality.

Bissell (T. L.). **Winter Quarters of the Spotted Cucumber Beetle and the Cowpea Curculio, and Results of Burning.**—*J. econ. Ent.* **32** no. 4 pp. 546–553, 3 figs., 6 refs. Menasha, Wis., 1939.

The following is based on the author's summary: During four winters (1935-39), samples from about 20 kinds of vegetation, covering approximately 500 sq. yards, were examined in central Georgia for overwintering adults of *Diabrotica duodecimpunctata*, F., and *Chalcodermus aeneus*, Boh., pests of maize and cowpeas, respectively. The literature on the winter quarters of these beetles, on which little has been published, is briefly reviewed. The method of taking the samples is described. They were from cultivated crops and field borders, and included leguminous and graminaceous plants and trees. Cowpeas, Bermuda grass [*Cynodon dactylon*], forest and broomsedge [*Andropogon virginicum*] furnished 66 per cent. of the samples. Nearly all were from the soil surface. The numbers of each species per sq. yard were calculated for each plant material in this series. Broomsedge held higher concentrations of each species (1·86 *Diabrotica* and 3·56 *Chalcodermus* per sq. yard) than any other distinct material, but six other materials were used by *D. duodecimpunctata* and seven by *C. aeneus*, the greatest concentration of the latter (13 per sq. yard) being found in thickets in which there were no examples of *D. duodecimpunctata*. The number of *Chalcodermus* per sq. yard in cowpeas was relatively low (1·17), but it is thought that in the aggregate a large proportion overwinters among dead cowpea plants. The weevils in winter quarters in broomsedge and other materials was found concentrated near cowpeas, the number per unit sample decreasing sharply with the distance from the cowpea fields. *C. aeneus* enters winter quarters about 15th October and

begins to leave them in the latter part of April or beginning of May ; the emergence period in 1938 extended into July. Both species pass the winter close to the surface of the soil, seldom penetrating to a depth of more than an inch. The few observations on the actual situation of the insects in broomsedge showed *D. duodecimpunctata* in the open within the plant bases and *C. aeneus* in shallow burrows in the soil. In other materials, *D. duodecimpunctata* rested on soil covered by leaves. Most of the weevils in cowpeas occurred on the ground or among dead leaves on the ground, while a few were in the surface soil. In a test of control by burning broomsedge, *D. duodecimpunctata* seemed to be readily killed, but only 23 per cent. of *C. aeneus* succumbed.

RAINWATER (C. F.) & ALLEN (N.). **Temperature in the Life History of *Rhopalosiphum subterraneum* Mason, a new Cotton Root Aphid.**—*J. econ. Ent.* **32** no. 4 pp. 557–560, 3 figs., 2 refs. Menasha, Wis., 1939.

The data presented in this paper are the major portions of the results obtained from rearing 70 consecutive generations of *Rhopalosiphum subterraneum*, Mason [*R.A.E.*, A **25** 736], a pest of cotton roots previously referred to as *Rhopalosiphum* sp. [**24** 25], in an open-air insectary in South Carolina from June 1934 to January 1936. The experimental procedure is described. The influence of light and humidity were reduced as far as possible so that temperature appeared to be the most important external variable. A statistical analysis of the data showed that there was a significant positive linear relationship between the average temperature and rate of reproduction, and a significant negative linear relationship between the average temperature and length of adult life. The relationship between the average mean temperature and the average length of the developmental period was curvilinear, and a second-degree parabola was found to express the relationship best. The average number of nymphs per female per day rose from 1·04 at 41·25°F. to 6·33 at 88·75°F. The average rate of reproduction increased by 0·107 nymph per female per day for each increase of 1°F. The average length of adult life decreased from 16·06 days at 51·25°F. to 6·90 at 86·25°F., and the average developmental period decreased from 17·5 days at 48·75°F. to 4·7 at 81·25, 83·75 and 86·25°F.

WATKINS (T. C.). **Biological and Control Studies on the Clover Leafhopper.**—*J. econ. Ent.* **32** no. 4 pp. 561–564, 1 ref. Menasha, Wis., 1939.

This is a brief summary of the results of experiments carried out in western New York in the summers of 1935–38, on the life-history and control of *Aceratagallia sanguinolenta*, Prov., which has been recognised for some years as a pest of clover and, since 1934, as the chief or only vector of the virus of yellow dwarf of potato [*R.A.E.*, A **24** 36, 298]. The adults overwinter and then lay their eggs singly in clover, usually in the petioles. In spring, the eggs hatch in about 11 days, and the five nymphal instars are completed in an average of 29·6 days. There are at least two, and usually three, generations a year in western New York, and if a warm summer is followed by a late autumn there is time for a partial fourth. Lists are given of 38

plants, belonging to 19 families, on which nymphs were observed in the field or obtained from eggs laid in cage experiments, and 8 plants, belonging to 4 of the same and 2 other families, on which unsuccessful attempts were made to induce oviposition. Clover and lucerne were the only plants on which leafhoppers were found in considerable numbers in the early part of the season or before they appeared on potatoes.

In a control experiment on clover in 1937 in which 8 treatments were compared, two pyrethrum dusts gave significantly better results than the next three materials, which in turn gave significant reductions in population. In a similar experiment in 1938, pyrethrum as a dust or spray gave significantly better results than a dust of copper sulphate and lime or Bordeaux mixture, both of which significantly reduced population as compared with the control. The addition of copper sulphate and lime in either form somewhat reduced the effectiveness of pyrethrum, but not significantly, the mixture of the two giving significantly better results than copper sulphate and lime alone. A further experiment was conducted on clover in 1938 to compare the toxicity of pyrethrum dusts with pyrethrin contents varying from 0·023 to 0·125 per cent. Talc was the diluent used, and it was also tested alone. All treatments, including talc, made significant reductions in population. All pyrethrum dusts gave significantly better reductions than talc alone, but their effectiveness did not vary directly with their pyrethrin content. In a potato dusting experiment carried out in 1937 by W. A. Rawlins, the only dusts that significantly reduced the populations of *A. sanguinolenta* were those containing pyrethrum.

Bigger (J. H.) & Flint (W. P.). **Studies on the Effect of Crop Rotation on some Insects infesting Corn Roots in Illinois.**—*J. econ. Ent.* **32** no. 4 pp. 565–571, 1 ref. Menasha, Wis., 1939.

The following is based on the authors' summary : Various rotation practices are maintained for long periods at the Illinois Agricultural Experiment Station. The rotations used are presumed to be adapted to livestock or grain systems of farming under the conditions of central Illinois, and are described. In general there were two conditions prevailing, a clover crop just before maize, or grain stubble without clover just before maize, preceded by wheat in both cases. An account is given of infestation of maize roots by various insects in different fields and different years between 1929 and 1938. The outstanding result of the observations was to show that recommendations for the use of rotations should be specific to the insect to be controlled. It was not desirable or practicable to modify the rotations used, though to have done so for even one year would at times have given entirely different results, but modifications can be made in practice and recommended on the basis of the data in this report.

Wilbur (D. A.) & Fritz (R.). **Use of Shoebox Emergence Cages in the Collection of Insects inhabiting Grasses.**—*J. econ. Ent.* **32** no. 4 pp. 571–573, 1 fig., 3 refs. Menasha, Wis., 1939.

Boxes of various sorts fitted with glass vials have long been used for collecting insects as they emerge from samples of soil, litter or the stems of plants. When large numbers are required, shoe boxes have

been found to be most practical, as they are readily available, are uniform in shape, stack well and occupy comparatively little space, and last several seasons. The only preparation necessary is to render the boxes light-proof by sticking small pieces of adhesive tape over the weak places and to fit them with vials in which the insects, attracted to the light, collect.

GRAHAM (C.) & CORY (E. N.). **Field Tests on Control of the Pea Aphid, *Illinoia pisi* (Kltb.).**—*J. econ. Ent.* **32** no. 4 pp. 574–576, 1 ref. Menasha, Wis., 1939.

Tests with rotenone-bearing materials for the control of *Macrosiphum onobrychis*, Boy. (*Illinoia pisi*, Kalt.) on peas were continued in Maryland in 1937 and 1938 [*cf. R.A.E.*, A **25** 562], and the results, in general, confirmed those obtained in 1936. In 1937, plots receiving 1 or 2 applications, at 100 U.S. gals. per acre, of sprays containing at least 2 lb. derris, with a rotenone content of 2·9 per cent. per 100 U.S. gals., and a spreader yielded 1,020 lb. shelled peas per acre or more, while plots similarly treated with nicotine sprays, including one that contained 1 lb. derris, gave 614–893 lb., and the controls gave an average yield of 446 lb. An experiment was carried out in western Maryland in 1938, but the Aphid infestation was not large enough to injure the peas. In an experiment in the same year on the Eastern Shore, various rotenone sprays and dusts were compared. Derris gave better control than cubé even though the rotenone content of the latter was higher. Dusts were inferior to sprays.

Experience extending over several years on the timing of sprays shows that the best results are obtained if the first application is made when the numbers of Aphids per tip and per sweep do not exceed 1 and 10, respectively. If the first spray is applied as much as 6–8 days before the blooming period, another application is likely to be necessary.

POTTS (S. F.). **Concentrated Mixtures for Aerial Spraying.**—*J. econ. Ent.* **32** no. 4 pp. 576–580. Menasha, Wis., 1939.

This paper is a summary and discussion of experience gained in laboratory and field investigations since 1936 on the preparation and properties of concentrated mixtures for spraying forest and shade trees and agricultural crops from an aeroplane or autogiro. The proportions of different ingredients needed to make economical and effective mixtures are given in tables. They include arsenates, derris and pyrethrum and their derivatives, thiodiphenylamine (phenothiazine), sulphur, lime-sulphur concentrate, fluorine compounds, nicotine compounds and Bordeaux mixture. In the laboratory, special attention was given to the compatibility of the mixtures, the ratio of the various ingredients necessary to make the most economical and most effective mixtures, the most suitable method of mixing, and the stability of the suspensions. In the field, special attention was given to atomisation, the degree to which spray ingredients dried out before reaching the foliage, the effect on different kinds of foliage, and the adherence. Most of the mixtures included oil to prevent or reduce evaporation of the water and other volatile ingredients and to increase adherence. It was used in very small quantities, caused no foliage injury, and seemed to reduce the injury commonly caused by certain insecticides when applied from the ground, apparently because the

formation of an oil film around the insecticide particles prevented them from being carried into solution by water. Methods of reducing drift are suggested. All kinds of foliage were covered equally well by concentrated sprays.

English (L. L.). **Derris as a Toxic Supplement to Oil Emulsions for the Control of the Purple Scale.**—*J. econ. Ent.* **32** no. 4 pp. 587–595, 9 figs., 8 refs. Menasha, Wis., 1939.

The following is based on the author's summary of this report on tests of the toxicity to *Lepidosaphes beckii*, Newm., of derris added to oil emulsions [*cf. R.A.E.*, A **27** 642]: Previous investigations on the addition of supplementary substances to oil sprays to increase their toxicity are reviewed from the literature. Experiments were carried out in Alabama in 1936–38 on artificially infested young orange plants in pots and on mature trees in the field. Emulsions prepared from several oils and emulsifying agents were used as carriers for derris. Mortality attributable to derris was obtained with a tank-mix spray of Mineral Seal Oil, having a viscosity of 41 (Saybolt), but not with tank-mix sprays of 56 and 83 viscosity white oils, a 32 viscosity refined kerosene or, at certain concentrations, a 64 viscosity oil. It was effective when used with diglycol laurate, but not with sodium lauryl sulphate. In experiments on potted plants, derris was an effective supplement to Mineral Seal Oil emulsions prepared with diglycol laurate, diglycol oleate, sodium oleyl sulphate, or powdered skim milk or with dried blood albumen in a tank-mix spray. Although the tank-mix emulsion with derris was the most effective spray applied to potted plants, the increase in effectiveness attributable to derris was low, and positive results were not obtained in the field. Greater increases in kill attributable to derris were obtained with emulsions prepared from diglycol laurate, diglycol oleate and sodium oleyl sulphate. Both derris (1½ lb. per 100 U.S. gals.) and Derrisol (1 : 1,000) reduced significantly the percentage of infested fruit on field plots when used as supplements to a 2 per cent. emulsion prepared from Mineral Seal Oil and diglycol oleate. An experiment with extracted and unextracted derris [*cf. loc. cit.*] showed that derris had a true toxic action on *L. beckii*.

Hungerford (H. B.). *Oberea bimaculata* (**Oliv.**) **injuring Perennial Asters.**—*J. econ. Ent.* **32** no. 4 p. 596. Menasha, Wis., 1939.

The raspberry cane borer, *Oberea bimaculata*, Ol., has been a serious pest of perennial asters in Garden City, Kansas, for several seasons. In June 1938, there were many characteristic oviposition marks and several adults were taken in an aster bed that had been severely injured during the previous season. Though removal of the girdled stems was advised, this Lamiid was again present in destructive numbers in 1939. There are no raspberry or blackberry patches in the neighbourhood.

Smith (M. W.). **Diphenylamine promising as Soil Poison against Subterranean Termites.**—*J. econ. Ent.* **32** no. 4 pp. 597–598, 1 ref. Menasha, Wis., 1939.

The effects of 10 organic compounds on subterranean termites were compared with those of orthodichlorobenzene as the standard by the

method of G. L. Hockenyos [*R.A.E.*, A **27** 422], washed sand being substituted for soil. In this paper, the results obtained with diphenylamine, which were outstanding, are dealt with. Ground mixtures of sand and crystals were used. When used at the rate of 1 part to 250 parts sand, by weight, orthodichlorobenzene killed the termites more rapidly than diphenylamine, but after 72 hours the former no longer killed the fresh termites nor prevented penetration, whereas the latter was as effective as at first or more so. At rates of 1 : 500 and 1 : 1,000, orthodichlorobenzene did not kill the termites, but prevented penetration for 60 and 48 hours, respectively, whereas diphenylamine was almost as effective at either concentration as at 1 : 250. Concentrations of 1 : 2,000, 1 : 4,000, 1 : 8,000 and 1 : 10,000 with a layer of untreated sand 5 mm. deep covering the treated sand, prevented penetration and killed the termites. The lowest concentration did not lose its effectiveness until 5 months had elapsed, and the 1 : 8,000 concentration was still effective after 7 months (when this paper was written). In the controls, termites penetrated the moist sand within an hour and remained alive for at least 3 months, when the controls were discontinued. Further tests indicated that to be effective in soil, dichlorobenzene must be used at higher concentrations than in sand. In a preliminary experiment on leaching, it was not easy to wash the diphenylamine from the upper to the lower layers of sand.

CASSIDY (J. F.) & SMITH (E.). **The Removal of Nicotine Spray Residue from Apples.**—*J. econ. Ent.* **32** no. 4 p. 598, 1 ref. Menasha, Wis., 1939.

Washing in the usual single-process machines with 1·5 per cent. hydrochloric acid at 110°F. reduced the nicotine residue of 0·01 grain per lb. on apples that had received six cover sprays of nicotine bentonite to 0·003 gr. per lb. or less. Acid was used, instead of the alkaline wash that should be employed for apples sprayed with nicotine, because the machine was already loaded with it for treatment of apples sprayed with lead arsenate. On the basis of the figures obtained, it would not be necessary to incur the expense of recharging the machine with an alkaline wash, if it is assumed that a nicotine tolerance would not exceed the arsenic tolerance of 0·01 gr. per lb. Treatment in a dual process machine charged with sodium silicate at 110°F. in one compartment and hydrochloric acid at 100° in a second left no nicotine residue on the apples.

BARBER (G. W.). **The Use of Insecticides in Light Mineral Oil for Corn Ear Worm Control.**—*J. econ. Ent.* **32** no. 4 p. 598, 1 ref. Menasha, Wis., 1939.

Light mineral oil applied to the tips of maize ears for the control of *Heliothis armigera*, Hb. (*obsoleta*, F.) [*R.A.E.*, A **26** 745] is more effective on varieties having ears with long, fairly tight husks than those the ears of which have short or loose husks. Moreover, oil alone has not proved effective in protecting ears against fifth- or sixth-instar larvae entering them after it was applied. In preliminary experiments, in February and March 1939, on the addition of an insecticide to the oil, in which 67 materials or combinations of materials were tested, it was found that the addition of 1 per cent. pyrethrins, especially in the form of oleoresin of pyrethrum, materially increased the effectiveness of the oil.

ROARK (R. C.). **Chemistry in Pest Control.**—*Soap* **15** no. 11 pp. 93, 95, 97, 123, 1 fig. New York, N.Y., 1939.

The author briefly discusses the more common chemical products that are used in the control of pests, bringing out such points as the forms in which they are usually obtainable, the pests against which they are chiefly used, the ways in which they are applied, and their toxicity to man and animals.

HOSKINS (W. M.) & BEN-AMOTZ (Y.). [**Factors concerned in the Deposit of Sprays. IV.**] **The Deposit of aqueous Solutions and of Oil Sprays.**—*Hilgardia* **12** no. 2 pp. 83–111, 6 figs., 21 refs. Berkeley, Calif., 1938. [Recd. 1939].

The following is the authors' summary of this paper, which is the fourth of a series [*cf. R.A.E.*, A **24** 165, 420; **26** 280]. The application of a spray is a dynamic process, and hence attempts to relate the deposit of oil obtained from various emulsions should be based upon measurements made under conditions approximating to those of use. With a standard surface of beeswax as the solid sprayed and a standard method of spraying, a study has been made of the relations between concentration of blood albumin, haemoglobin or sodium oleate and the following properties: amount of the aqueous solution and of the accessory substance deposited in the absence of oil; deposit of oil, of aqueous phase, of accessory substance and of all components when emulsions were used; ease of wetting of wax by solutions of the accessory substances and by the entire emulsion; replacement of aqueous phase by oil; and stability of the emulsions.

The amount of oil deposit can be explained at least qualitatively as follows: When only oil and water are present, the emulsion wets poorly, and drops roll on the surface with a minimum area of contact. The addition of a protein promotes wetting and opportunity for the oil to reach the surface. Hence deposit is increased until formation of large sheets of the aqueous phase upon the surface and resistance to displacement of the aqueous phase by oil lead to a decrease in oil deposit with higher concentration of protein. Soap promotes wetting so little that a corresponding increase in oil deposit does not occur. With all three accessory substances, the increase in stability of the emulsions diminishes oil deposit. Water-soluble substances follow the aqueous phase and increase spreading of oil only after the water has evaporated.

HOSKINS (W. M.), BOYCE (A. M.) & LAMIMAN (J. F.). **The Use of Selenium in Sprays for the Control of Mites on Citrus and Grapes.**—*Hilgardia* **12** no. 2 pp. 113–175, 1 fig., 5 pp. refs. Berkeley, Calif., 1938. [Recd. 1939.]

An account is given of the chemical properties of selenium and its compounds and methods of selenium analysis. The proprietary product Selocide, which is stated to be a 30 per cent. solution of a mixture of potassium hydroxide, ammonium hydroxide, sulphur and selenium in the proportions corresponding to the empirical formula $(KNH_4S)_5$ Se, contains 48 gm. selenium per litre. The reactions that occur when it is diluted with water for spraying do not appear to be known, but a large part, if not all, of the selenium is liberated as very finely divided dark-red particles, which appear to

be the red allotropic form of the element. When finely ground sulphur is added to Selocide, the residue has a persistent effect that is shown by neither component alone. There is no chemical evidence that a compound is formed, but the effect may be due to some new product, such as selenium sulphide. Selocide gave satisfactory control of mites on *Citrus* and vines in preliminary tests, and further investigations were made in California on its effectiveness, the amounts of selenium residue on fruit as the result of various spray programmes [*R.A.E.*, A **26** 131], the accumulation of selenium in the soil below sprayed plants, and its absorption by the plants [*loc. cit.*].

The results are given of tests of Selocide against *Paratetranychus citri*, McG., on *Citrus* [**24** 419]. A mixture of 1 U.S. pint Selocide, 1 lb. wettable sulphur, ½ U.S. gals. light-medium oil and 3–4 oz. sodium caseinate in 100 U.S. gals. water gave satisfactory control of both *P. citri* and *Tetranychus sexmaculatus*, Riley, and it is suggested that increasing the wettable sulphur to 4–6 lb. per 100 U.S. gals. water would make the spray also effective against *Phyllocoptruta* (*Phyllocoptes*) *oleivorus*, Ashm., and *Scirtothrips citri*, Moult. Selocide may be used on *Citrus* with nicotine sulphate, zinc oxide or zinc sulphide, but is incompatible with a mixture of zinc sulphate and hydrated lime. Tests of Selocide against *Tetranychus pacificus*, McG., on vines, begun in 1932 [**21** 565], were continued. The vines were sprayed in June 1933, as soon as damage due to mites was observed, but although the initial mortality was high, they became reinfested after about 4 weeks, and in many cases, additional sprays were necessary to prevent defoliation. A combination of Selocide and wettable sulphur gave a high initial kill and left a residue that killed the mites that hatched later and those that were moulting at the time of application. Reinfestation was therefore greatly delayed, and when the vines were sprayed in late June or early July, the leaves remained on them, and the crop matured, though some damage occurred before the mites began to hibernate in August and September. Selocide diluted to 1 : 800 gave satisfactory results under certain conditions, but dilutions of 1 : 600 or 1 : 500 were found to be more effective.

After several years' use of Selocide, there was no evidence of harmful effects upon the plants, and fruit injury had occurred to only a limited extent in certain districts. The literature on the occurrence and toxicity of selenium to man is summarised. There is evidence that three parts per million selenium in the whole diet, which could not be obtained from *Citrus* fruit or grapes, causes no apparent injury. It is therefore concluded that the use of Selocide on *Citrus* and grapes is not dangerous under the prevalent conditions of production in California.

MACKIE (D. B.) & CARTER (W. B.). **Supplementary Control of Codling Moth.**—*Bull. Dep. Agric. Calif.* **28** no. 6 pp. 378–386, 3 figs. Sacramento, Calif., 1939.

About once in seven years, the overwintering brood of the codling moth [*Cydia pomonella*, L.] emerges early in California and picking of early pears coincides with the hatching of the second-generation larvae [*R.A.E.*, A **28** 63]; considerable loss results if the first brood has not been effectively controlled. In this paper, control measures supplementary to spraying with lead arsenate are discussed. Banding and scraping of the trees are briefly dealt with. The control of

hibernating larvae in picking boxes by steam is costly. Tests are recorded showing that methyl bromide is a satisfactory fumigant for the boxes if used at the rate of 1 lb. per 1,000 cu. ft. space for 24 hours even at 45°F. Complete kill of larvae in pears was given by as little as ½ lb. per 1,000 cu. ft. for 2 hours at 88°F.

MACKIE (D. B.) & CARTER (W. B.). **Observations on *Hypera brunneipennis* and its Destruction in Baled Hay by Fumigation.**—*Bull. Dep. Agric. Calif.* **28** no. 6 pp. 387–392, 1 fig. Sacramento, Calif., 1939.

Hypera brunneipennis, Boh., which in May 1939 was found to be established near Yuma in the extreme south-west of Arizona and in the south-east of California on leguminous forage plants [*cf. R.A.E.*, A **28** 120] is thought to have one generation a year, reproduction occurring in the winter. The eggs are laid on the plant stems, and the larvae feed on the foliage and pupate in a cocoon inside rolled leaves. Adult emergence was practically complete by 5th May in 1939, and the adults were seeking sites for aestivation. It is generally conceded that they are nocturnal in habit. Many were found in the ground around the base of the stools of lucerne plants. They sought shelter when disturbed. Some were also found in a borer hole in an old plank, in crevices in bark of *Eucalyptus* and in offshoots of date palm. The weevil is thought to have been present in Arizona for a number of years. Under the conditions prevailing at Yuma, it showed a preference for the bitter clovers of the genus *Melilotus*, both *indica* and *alba* being fed on liberally by adults and larvae. In a plot of lucerne from which it had been removed by irrigation, the returning adults completely defoliated the first row down to stubble and fed heavily on the next, but did no particular damage beyond this.

After the discovery of *H. brunneipennis*, movement of lucerne hay into California was suspended while satisfactory treatments were being devised. Preliminary experiments, with the granary weevil [*Calandra granaria*, L.] and *H. variabilis*, Hbst., as test insects, on the penetration of methyl bromide established that lucerne hay could be treated economically, and more extensive treatments were begun at Yuma under industrial conditions. A series of experiments carried out in the first week of June, in co-operation with W. C. Haney, in which adults of *H. brunneipennis* in cages of perforated copper tubing were buried in the centres of bales of tightly compressed lucerne hay in ordinary freight and refrigerator cars loaded to full capacity, showed that ordinary freight cars are quite unsuitable for fumigation, but complete mortality in refrigerator cars was obtained with a dosage of 1·1 lb. methyl bromide per 1,000 cu. ft. in the baled hay and also in bags of flax seed, the periods of exposure varying from 6 to 24 hours for the hay and 12 to 24 for the seed. Complete mortality was also obtained in 12 hours when bales of lucerne hay were fumigated at 1 lb. per 1,000 cu. ft. under a gas-proof tarpaulin.

LOCKWOOD (S.). **The Grasshopper Outbreak in 1939.**—*Bull. Dep. Agric. Calif.* **28** no. 6 pp. 393–411, 5 figs. Sacramento, Calif., 1939.

In the summer of 1938, grasshoppers were more numerous in California than in previous years, and a serious outbreak developed in

1939. *Melanoplus mexicanus*, Sauss., was the most important species in the hills, *Camnula pellucida*, Scudd., and *Oedaleonotus enigma*, Scudd., were most prevalent in the hills, and *Melanoplus devastator*, Scudd., was numerous on the coastal lowlands ; less important species in the north included *M. packardi*, Scudd., and *M. bivittatus*, Say.

The extent of damage was increased owing to repeated hatchings, which occurred from March to later part of June, following rain storms. Much of the infested crop land bordered on uncultivated areas, where the infestation originated. Hoppers of *Oedaleonotus enigma* began to move out of the grassland soon after they hatched. The crops damaged included cereals, cotton, flax, lucerne, beets, melons, potatoes, lettuce, olives, *Citrus*, fruit trees and vines. Particularly heavy damage was caused to range lands where the grasshoppers hatched, and in some areas grasses were eaten to the ground.

Control was organised by the State Department of Agriculture, and poison bait prepared with 1 U.S. quart sodium arsenite diluted in 12–16 U.S. gals. water and mixed with 100 lb. bran, or bran and sawdust, was used. Dried beet pulp was used in some places instead of bran, while in others dried orange pulp gave good results. Apart from broadcasting bait by hand, mechanical spreaders and aeroplanes were also used. Flying at about 50 feet above the crop, an aeroplane could cover about 200 acres in an hour of actual flying time. As a result of the control measures, the final losses of crops were not very great. A survey of the results by counties is given.

Smith (R. H.). **European Red Mite in Southern California.**—*Bull. Dep. Agric. Calif.* **28** no. 6 pp. 412–415, 17 refs. Sacramento, Calif., 1939.

Paratetranchyus pilosus, C. & F., was not found in a search mainly of apple and pear trees in southern California begun in the spring of 1936 and extending over 2½ years, but was discovered in the autumn of 1938 in large numbers on peach and walnuts. Plums were also infested by the mite, though less heavily, and individuals were taken on an apricot tree and on *Cotoneaster pannosa*, *Pyracantha* sp., and *Pittosporum undulatum*. A few were found on apple, pear and avocado trees growing very near to heavily infested peach trees. The most common mite on walnut at Carpinteria was *P. ilicis*, McG., and the most common on peach was *P. citri*, McG. The food-plants of *P. pilosus* are reviewed from the literature, and the character of infestation and injury is very briefly described.

Buchanan (L. L.). **The Species of *Pantomorus* of America North of Mexico.**—*Misc. Publ. U.S. Dep. Agric.* no. 341, 39 pp., 5 figs. Washington, D.C., 1939.

The genera *Pantomorus* and *Naupactus* together include some 240 species, all of which are indigenous to the New World, the majority being natives of South America. This publication deals with the taxonomy of the 14 species and varieties now known in the United States ; two species and one variety are new. All of them are assigned to *Pantomorus*, and they are divided under 4 subgenera, namely, *Graphognathus*, subgen. n., *Phacepholis*, Horn, *Atrichonotus*, subgen. n., and *Asynonychus*, Crotch. The 12 generic names that are or may prove

to be synonymous with *Naupactus* or *Pantomorus* or are available as names for subgenera are briefly discussed.

Details of the bionomics are imperfectly known, but the species of *Naupactus* have functional hind wings and those of *Pantomorus* have not. It is probable that all the species of both genera are root feeders as larvae and general feeders as adults. Of the species now present in the United States, only those comprising the subgenus *Phacepholis* are known to be gamogenetic and indigenous; all the others are known or suspected to be parthenogenetic, and, with the possible exception of *Pantomorus* (*Asynonychus*) *godmani*, Crotch, have either been imported from South America or are most closely allied to species occurring there. Besides *P. godmani*, those that are important as pests are the white-fringed beetle, *Pantomorus* (*Naupactus*) *leucoloma*, Boh. [*R.A.E.*, *A* **25** 700, etc.] and *P. peregrinus*, sp. n., which was previously recorded as a species closely related to it [**26** 580; **27** 275]. These are the two species for which the subgenus *Graphognathus* is erected.

Parthenogenesis is an important factor favouring dispersal and establishment and is believed to be more common among Curculionids than was previously supposed. F. F. Smith, in work as yet unpublished, bred four parthenogenetic generations of *P. godmani* during 1927–29 and states that 1,200 adults of this species collected from five States during the same period were all females. All available specimens of *P. peregrinus* are also females, and the occurrence of parthenogenesis has been demonstrated in *P. leucoloma* [**26** 131], as well as in some weevils of other genera that have been introduced into the United States [**21** 195; **24** 385] including *Listroderes obliquus*, Klug [*cf.* **25** 292] and *Otiorrhynchus* (*Brachyrrhinus*) *ligustici*, L. All known parthenogenetic weevils are unable to fly.

KAMAL (M.). **Biological Studies on some Hymenopterous Parasites of Aphidophagous Syrphidae.**—*Bull. Min. Agric. Egypt* no. 207, 111 pp., 101 figs., 6 pp. refs. Cairo [1939]. Price *P.T.* 10.

This paper deals with 13 species of primary parasites and one hyperparasite reared from Syrphids predacious on Aphids in California. It includes records of their hosts and seasonal occurrence, and in some cases notes on their biology and descriptions of the immature stages or adults. It also contains an account of the morphology and anatomy of Syrphid larvae and pupae and the habits of the larvae, brief notes on natural enemies of Syrphids other than parasites, and descriptions of the biology of the parasite larvae in general and their structural adaptation to their hosts.

BRUCH (C.). **Algunas observaciones biologicas sobre** *Schistocerca infumata* **Scudd. (Acrid.)**—*Rev. Mus. La Plata* (N.S.) **1** Zool. 209–216, 6 pls. Buenos Aires, 1939.

It is stated in the introduction to this paper that breeding experiments with *Schistocerca cancellata*, Serv., in Argentina proved that various environmental factors produce changes in the life-cycle and, especially, in the coloration of this species, which normally leads a solitary life. These changes suggest that *S. cancellata* may represent a solitary phase of *S. paranensis*, Burm., but the experimental evidence

is not considered conclusive, and field observers [*cf. R.A.E.*, A **28** 60] consider them distinct species. If the specific identity of *S. paranensis* and *S. cancellata* is finally established, the latter name, which has priority, will have to be used for the species. The main body of the paper deals with the results of breeding experiments with *S. infumata*, Scudd., a relatively non-injurious species that occurs in the northern coastal regions of Argentina and in Brazil and was also shown to undergo changes in coloration.

WILLE (J. E.). **Insectos que atacan al agodonero y a la caña de azúcar en el Perú.** [Insects attacking Cotton and Sugar-cane in Peru.]—*Bol. Estac. exp. agríc. La Molina* no. 17, 40 pp., 17 pls. Lima, 1939.

Much of the first edition of this bulletin, which was by C. H. T. Townsend [*R.A.E.*, A **17** 100], is reprinted in this second edition, which also follows the original arrangement, but parts of the text have been revised and material added to include data obtained since 1928. In all, 58 pests of cotton and 18 of sugar-cane are dealt with.

PEMBERTON (C. E.). **Entomology.**—*Rep. Comm. Exp. Sta. Hawaii. Sug. Pl. Ass. 1937* pp. 20–27. Honolulu, 1938. [Recd. 1939.]

An account is given of work on insect pests, chiefly those of sugar-cane, in Hawaii during 1936–37 ; a subsequent report has already been noticed [*R.A.E.*, A **27** 366]. *Agromyza simplex*, Lw., was recorded on asparagus in May 1937, having probably been introduced from California. The larvae mine below the epidermis of the stems, sometimes completely encircling them. Adults of *Coccinella arcuata*, F., received from Guam., where this Coccinellid is of importance in the control of *Aphis maidis*, Fitch, on maize, were liberated in a field of maize on Oahu. A previous attempt to establish this species, or one closely allied to it, by means of material imported from Australia in 1919 [**8** 72] was unsuccessful, although the Coccinellid was then easily reared in the laboratory. The Eupelmid, *Cerambycobius cushmani*, Crwf., a parasite of the pepper [*Capsicum*] weevil [*Anthonomus eugenii*, Cano] that was introduced from Guatemala in 1934, was reared in June 1937 from *Bruchus sallaei*, Sharp, in pods of *Acacia farnesiana*. This Bruchid also attacks the pods of algaroba [*Ceratonia siliqua*] in Hawaii.

EVANS (I. B. Pole). **Pasture, Crop and Insect Problems of the Union [of South Africa]. Annual Report of the Division of Plant Industry.** *Fmg in S. Afr.* 1938 repr. no. 105, 20 pp., 11 figs. Pretoria, 1938. [Recd. 1939.]

A section of this report (pp. 14–20) deals with beneficial and injurious insects and with diseases of plants observed during 1937–38 in various parts of the Union of South Africa.

The Pyralid, *Cactoblastis cactorum*, Berg, continued to give satisfactory control of prickly-pear (*Opuntia*). The three oldest colonies [*cf. R.A.E.*, A **22** 616] have each spread over an area of more than 400 sq. miles in four years. During 1937–38, 52 million eggs were produced at the three breeding stations, 13 million were collected in the field, and 250 colonies were established ; a small

percentage of the colonies failed to progress, owing to such causes as floods or arid and shelterless soil conditions, and a few were damaged by baboons and monkeys. *Cactoblastis* did not thrive on *O. spinulifera*, which is apparently too mucilaginous, or *O. tardiospina*. The Coccid, *Dactylopius confusus*, Ckll., continued to give excellent control of *O. aurantiaca*, and *D. coccus*, Costa, gave further promise of being a useful supplement to *Cactoblastis*. *D. opuntiae*, Ckll., has become well established on prickly-pear in the field.

Observations on *Ceratitis capitata*, Wied., showed that the flies become abundant in deciduous orchards after the fruit has been picked, and that a much higher population shelters in apricots, plums and high-trellised vines than in the low-trellised ones or peach trees. The use of baits after the crops are harvested is therefore of importance. The damage caused by the Saturniid, *Nudaurelia cytherea*, Cram., to pines in the western part of Cape Province [*cf.* **24** 335] has increased. Control measures consisted in hand-picking of eggs and larvae and collection of pupae. The use of pigs to destroy the pupae has given good results in preliminary investigations. The incidence of the bagworm, *Acanthopsyche* (*Chalioides*) *junodi*, Heyl., on wattle [*Acacia*] is markedly increasing, and in view of the promising results obtained in October 1937 by the application from an aeroplane of a dust of cryolite [*cf.* **26** 203], which gave 95 per cent. mortality, dusting on a large scale is being arranged.

Serious damage to stored cowpeas was caused by *Bruchus analis*, F., which has not previously been recorded from South Africa. The Bruchids reduced the germinating capacity of the seeds stored in granaries, and also infested cowpeas in the field before harvesting. In the course of investigations on breeding *Laphygma exempta*, Wlk., it was observed that the optimum conditions consisted in high temperature during the oviposition period and the presence of fresh succulent grasses for the young larvae. Outbreaks generally occur when a period of drought associated with high temperatures is followed by fairly good rains resulting in an abundance of fresh young grass. *Gladiolus* was injured in many districts by *Taenothrips simplex*, Morison, and the weevil, *Timola notata*, Fhs., was observed ovipositing in the stems. The Tettigoniid, *Maxentius pinguis*, Wlk., caused serious damage by feeding on ripening peaches and apricots on the trees.

Further field observations on the swarming of *Locustana pardalina*, Wlk., carried out in the Middelburg district in Cape Province [*cf.* **27** 93] indicated that incipient swarming can take place even when only two summer months out of the eight receive an inch of effective rainfall. Such swarming occurred in the season of 1937–38 in the seventh generation that had developed since the observations were started in 1935 [*cf.* **27** 393]. Hopper mortality in the preceding six generations averaged 87 per cent., and the fact that swarming nevertheless occurred indicates that this locust has a very high rate of increase. Experiments in April and May showed that poison bait can be used effectively against ovipositing swarms during the winter months; it is of no use, however, in the case of rapidly migrating swarms. In experiments on substitutes in baits for sodium arsenite, which scorches plants and the hands of operators, calcium chloracetate was too unreliable, and white arsenic was ineffective against *L. pardalina*, though in British Bechuanaland it gave good results in baits against *Nomadacris septemfasciata*, Serv., provided that it was used at about twice the concentration required for sodium arsenite.

Kassab [Cassab] (A.). **The Control of Mole-crickets with Barium Fluosilicate.**—*Bull. Minist. Agric. Egypt.* no. 193, 13 pp., 6 pls., 29 refs. Cairo, 1939.

In laboratory and field investigations in Egypt, barium fluosilicate was found to be as effective as zinc phosphide in baits for the control of *Gryllotalpa* [*R.A.E.*, A **23** 160 ; **26** 457], and is cheaper and less toxic to man and domestic animals. The bait is prepared by thoroughly moistening 20 lb. broken rice or maize with ½ gal. water and then mixing 1 lb. barium fluosilicate with it, and is best applied during March–October at the rate of 26–33 lb. dry material per acre in the evening after rain or irrigation, when the crickets come to the surface. The soil should not be watered or cultivated for at least 10 days after the treatment, and although the bait remains toxic for 9–10 days, it is best used soon after preparation, since the moist grain quickly rots and becomes less attractive.

In laboratory experiments, complete mortality of crickets that ingested the bait was obtained after 45 hours at 25°C. [77°F.], whereas zinc phosphide is equally effective after only 15 hours under the same conditions ; at higher temperatures the effect was more rapid. In December 1934, crickets were not killed until 7 days after ingesting the bait, but became paralysed after 3 days. Barium fluosilicate (80–95 per cent. pure), mixed with talc at the rate of 5 and 10 per cent., did not injure the leaves of various vegetables, cereals and other economic plants in laboratory experiments at temperatures of 21–27°C. [69·8°–80·6°F.], and since the bait does not adhere for long to leaves it can safely be employed among plants grown for consumption. Domestic animals were not attracted by the bait, but a dose of 0·1 gm. barium fluosilicate was toxic to hens, and poultry should therefore be excluded from treated land for a week after the application.

Notes are given on the chemical properties of barium fluosilicate, the quality required for baits, the costs of applying them, the type of injury caused by *Gryllotalpa*, the method of examining treated fields, the precautions that should be observed during the preparation and application of the bait, and the treatment of cases of poisoning.

Picard (F.) & Balachowsky (A.). **A propos des *Porphyrophora* Brandt, nuisibles aux céréales dans le bassin méditerranéen.**—*Bull. Soc. ent. Fr.* **44** no. 7–8 pp. 118–120, 7 refs. Paris, 1939.

During May 1938, an adult female and cysts of a species of *Porphyrophora* that had seriously injured wheat in Syria were received for identification and were found to agree in all constant morphological characters with *P.* (*Margarodes*) *polonica*, L., which occurs throughout Europe and was known to live on the roots of a great number of perennials and annuals excluding graminaceous plants ; they were, moreover, certainly identical with *P.* (*M.*) *parieli*, Vayss., described from the roots of barley in Morocco [*R.A.E.*, A **9** 57] and *P. bolivari*, Balachowsky, described from the roots of *Arenaria tetraquetra* in Andalusia, and both of these, it is concluded, are synonyms of *P. polonica*, which is thereby shown to have an extensive distribution in the Mediterranean region and to be able to live on graminaceous plants. It is also considered that *P. hameli*, Brandt [**22** 170 ; **23** 675], which was inadequately described from the roots of *Poa pungens*

and *Dactylis laevis* in Armenia, and a Coccid reported as attacking the roots of wheat in Armenia and identified as *P. hameli* [*cf.* also **22** 170 ; **23** 675] are probably identical with *P. polonica*.

VAYSSIÈRE (P.). **Un nouveau genre de cochenille à Panama.**—*Bull. Soc. ent. Fr.* **44** no. 9–10 pp. 124–127, 1 pl., 1 fig. Paris, 1939.

Descriptions are given of *Nautococcus*, gen. n. (MONOPHLEBINAE), and of the female, first-instar larva and last stage larva (from an exuvia) of *N. schraderae*, sp. n., taken in February 1937 on three food-plants including *Anona spraguei* on Barro Colorado Island, Panama. Males were also taken.

BALACHOWSKY (A.). **Sur les dégâts provoqués par la " Galéruque de l'Aulne "** (*Agelastica alni* **L.**) **dans les cultures fruitières du sud-ouest de la France, par modification accidentelle de son régime alimentaire.**—*Bull. Soc. ent. Fr.* **44** no. 11–12 pp. 174–175, 9 refs. Paris, 1939.

In view of an infestation of fruit-trees and roses in four Departments of south-western France in April 1939 by adults of *Agelastica alni*, L. [*cf. R.A.E.*, A **28** 54], the author discusses the food-plants of *A. alni*, compares this accidental modification of diet with similar examples in other Galerucids, and shows from records in the literature [**11** 425 ; **13** 378] that the genus *Agelastica* has a marked affinity for rosaceous trees.

MALENOTTI (E.). **Le ustioni da fitofarmaci.** [Scorching of Plants by Insecticides and Fungicides.]—*Italia agric.* **76** no. 8 pp. 615–632, 23 figs., 11 refs. Rome, 1939.

The various ways in which injury is sometimes caused to the tissues of plants by insecticides and fungicides are reviewed. Scorching may be due to preparations of bad quality, or preparations of good quality applied incorrectly or under conditions that render them injurious, and examples are given from actual practice in Italy.

In one instance, tar distillate was sprayed on apple trees when snow 8–12 ins. deep covered wheat and rye beneath them. It was believed that the drips would be diluted by the snow and rendered harmless, but the cereals were completely destroyed. The author subsequently found that tar-distillate emulsions filtered through crushed ice were broken down. A screen of canvas mounted on a frame is now erected to catch spray that passes a tree and would otherwise reach plants growing near it.

DI STEFANO (G.). **Contributo alla conoscenza dell'** *Orgya antiqua*, **L. (Lepid. Lymantriidae).** [A Contribution to the Knowledge of *O. antiqua*.]—*Redia* **25** pp. 303–318, 7 figs., 2 pls. Florence, 1939.

Detailed descriptions are given of all stages of the Lymantriid, *Orgyia antiqua*, L., together with an account of its bionomics as observed in the laboratory in Florence. Its food-plants in Tuscany include apple, pear, cherry, plum, hazel [*Corylus*] and castor [*Ricinus communis*]. There were four generations in Tuscany in 1938 ; the overwintered eggs hatched late in May, and adults were present during

about 20th–30th June, 20th–31st July, 10th–31st August and 10th–20th October. During the first three instars, the larvae feed on the upper surface of the leaves and attack the parenchyma, leaving the veins and the epidermis of the lower surface intact, but in the fourth instar they leave only the larger veins, and during the fifth, only the petiole. In May–June, the larval and pupal stages lasted about 17–19 and 7–10 days, respectively. Pupation takes place in a cocoon spun on the trunk or branches, or between two adjacent leaves. The females, which have vestigial wings, pupate and emerge 1–2 days after the males, and are fertilised and oviposit on or close to the empty cocoon. Pairing appears to take place only once, and the males die a few days after it. The females begin to oviposit about half an hour after pairing, and the oviposition period lasts 3–4 days. Eggs deposited by unfertilised females had not hatched 10 months later.

If present in abundance, *O. antiqua* is a serious pest. The collection and destruction of the eggs is the measure advised. If necessary, a 0·5 per cent. suspension of lead arsenate should be applied against the larvae, preferably against young larvae of the overwintered generation.

Manolache (C. I.), Dobreanu (E.) & Manolache (F.). **Cercetări asupra biologiei insectei *Cassida viridis* L.** [Investigations on the Biology of *C. viridis*.]—*Anal. Inst. Cerc. agron. Român.* **10** pp. 435–457, 2 col. pls., 17 figs., 5 diagr., 32 refs. Bucharest, 1939. (With a Summary in French.)

Cassida viridis, L., all stages of which are briefly described, is widely distributed in Rumania and occurs in the mountains up to an altitude of about 3,800 ft., as well as in low-lying marshy districts, along the banks of rivers and streams and in forests. It sometimes becomes injurious on labiate medicinal plants, and since the cultivation of some of these plants had recently been undertaken on a large scale, laboratory and field investigations on its bionomics were carried out in different parts of the country in 1933–36. The plants on which infestation was observed were *Salvia glutinosa*, *S. verticillata*, *Lycopus europaeus*, *Melissa officinalis*, *Stachys*, and various wild and cultivated species of mint (*Mentha*). In the laboratory, *Ocimum basilicum* was the preferred food-plant. The young larvae skeletonise the leaves, and the older larvae and adults perforate them.

Only one generation a year was observed in the field, but two were obtained in the laboratory. The adults began to enter hibernation under fallen leaves or in the top layer of humus in the second half of September, when the mean temperature fell below 8-9°C. [46·4–48·2°F.], and abandoned their shelters at the end of April or beginning of May, when it rose above 9°C. Pairing started 4–5 days later at a mean temperature of over 12°C. [53·6°F.]. In the district of Sinaia, in the mountains of central Rumania, the first batches of eggs were found at the beginning of May. Oviposition occurred in May, June and even July, the eggs being laid on the stems or occasionally on the leaves and petioles of the food-plants. The process of oviposition is described. The number of eggs deposited varied greatly; one female laid 27 batches of 9–12 eggs in 85 days, and another 132 batches of 3–8 eggs in 55. In the laboratory, at 20–21°C. [68–69·8°F.], oviposition began 3–4 days after the first pairing. At 30 and 21–22°C. [86 and 69·8–71·6°F.], the egg stage occupied 5 and 7–9 days. In the district of

Sinaia, at a mean temperature of 13–15°C. [55·4–59°F.], it lasted 3–4 weeks.

Young larvae, and those in the fifth instar, congregrate on the lower surface of the leaves, whereas those of the third and fourth instars also occur on the upper surface. In the laboratory, the larval stage lasted 17–19 days at 22–23° [71·6–73·4°F.] and 12 days at 30°C. In the mountains, it occupied 30–35 days in June and July at temperatures of 11–19°C. [51·8–66·2°F.]. The optimum temperatures for larval development appear to be 16–18°C. [60·8–64·4°F.] in Sinaia and 20–22°C. in the plain. The larvae are enclosed in a case made of excreta. The effect of insufficient nutrition was studied by starving the larvae on alternate days. The great majority of the young larvae died, but most of those that had reached the fourth or fifth instar before they were tested completed their development normally.

Pupation usually took place on the lower surface of the leaves. Prior to pupating, the larva cleans off its case and undergoes a period of rest, which in the laboratory lasted 48–73 hours. At temperatures of 22–23 and 30°C., the pupal stage occupied 6–7 and 4 days, and the life-cycle from egg to adult was completed in 32–34 and 20–22 days, respectively; in the field, at temperatures of 14–19°C. [57·2–66·2°F.], the pupal stage and the life-cycle lasted 13–15 and 60–70 days. The adults emerged at the end of July or beginning of August in the mountains, and in the second half of July in the plain.

The Pentatomids, *Troilus luridus*, F., and *Picromerus bidens*, L., were predacious on the larvae, pupae and adults. The eggs were parasitised by the Eulophid, *Tetracampe galerucae*, Boy., the larvae by *Tetrastichus rhosaces*, Wlk., and *T. cassidarum*, Ratz., and the pupae by a Chalcid resembling *Brachymeria* (*Chalcis*) *punctulata*, Först. From one pupa, a female of a variety of *Pimpla turionellae*, L., was obtained.

In experiments on control, good results were obtained by spraying with lead arsenate or dusting with calcium arsenate, but since arsenicals should not be applied to medicinal plants, dusting with derris preparations or cultural and mechanical control measures are preferable.

Polizu (S.). **Curculionidele dăunătoare viţei de vie.** [Curculionids injurious to Vine.]—*Bul. agric. Basarabia* 1939 no. 5 extract 2 cols. Chişinău, October, 1939.

In Bessarabia, vines are considerably damaged by *Otiorrhynchus* (*Dorymerus*) *tristis*, Scop., and *Byctiscus betulae*, L. (*Rhynchites betuleti*, F.) and are occasionally attacked by *Psalidium maxillosum*, F., which is usually a pest of beet. The adults of these weevils are briefly described. *O. tristis*, which was first observed near the town of Chişinău in 1932 but has since spread to the north, occurs chiefly in vineyards on sandy soil and elevated ground. The adults appear in the vineyards soon after the snow melts in spring and feed on weeds. As soon as the vines are uncovered, in the second half of April, they migrate to them and attack the developing buds. They pair at the end of April, are most abundant in May, and persist until about mid-June. They feed on the buds and young leaves and are most active during the hottest hours of the day. At night they hide under clods of earth or in the soil close to the surface. As a result of the injury to the buds, the stems of the vines dry up. The eggs are laid on the leaves, and the young larvae drop to the ground and make their way

to the roots of the vines, on which they feed. The adults also attack the buds of gooseberries.

The adults of *B. betulae* feed on the parenchyma of the leaves of fruit trees and vines in May. The females make incisions in young shoots, which cause them to wither and the leaves to roll, and oviposit inside the rolled leaves. The larvae feed on the dead tissues of the leaves and later pupate in the soil.

Ṣuster (P. M.). **Observations biologiques sur les larves de Scarabaeidae (Coleoptera).**—*C. R. Inst. Sci. Roumanie* **3** no. 1 pp. 52–55. Bucharest, 1939.

Tachinids bred by the author from Lamellicorn larvae in Rumania comprised: *Dexia rustica*, F., from *Melolontha melolontha*, L., and *Amphimallus solstitialis*, L.; *Dexiosoma caninum*, F., from *M. melolontha*; *Billaea pectinata*, Mg., from *A. solstitialis* and *Cetonia aurata*, L.; and *B. microcera*, Rond., from *Potosia aeruginosa*, Dru.

Ionescu (M. A.). **Sur l'oecologie du termite lucifuge (*Reticulitermes* (*Leucotermes*) *lucifugus* Rossi).**—*C. R. Inst. Sci. Roumanie* **3** no. 2 pp. 180–184, 35 refs. Bucharest, 1939.

Observations have shown that *Reticulitermes lucifugus*, Rossi, which is the commonest termite in southern and south-eastern Europe, is more widely distributed in Rumania than was previously known. It has been recorded from 23 localities and has been observed in woodwork in houses in Bucharest, and elsewhere in oak and hornbeam (*Carpinus*) in forests, in a walnut tree, and in the stems of vines and apricots. In 1938, winged forms were observed as early as the beginning of April; they originated from a colony in the wood of a floor near a stove. They do not normally appear until early May.

Kearns (H. G. H.) & Martin (H.). **Combined washes. Progress Report V.**—*Rep. agric. hort. Res. Sta. Bristol 1938* pp. 66–71, 6 refs. Bristol [1939].

Investigations on combined sprays in south-western England [*cf. R.A.E.*, A **26** 708, etc.] were continued in 1938, when trials were made to determine whether single applications of combined sprays comprising petroleum oil and a number of ovicides for the control of Aphids and *Psylla mali*, Schm., can safely be made at bud burst stage on apple, and at the same time on currant and gooseberry, instead of the schedule in general use, which comprises an application of a tar distillate during the dormant period to control Aphids and *P. mali* followed by one of petroleum oil at bud burst stage against Capsids [*cf.* **27** 236]. The value of this treatment against *Anuraphis padi*, L., on plum was also tested.

Grade E petroleum oil was emulsified with a 20 per cent. solution of sulphite lye to stock emulsions containing 67 per cent. oil. The washes tested were 0·3 per cent. of a preparation of β-butoxy-β′-thiocyanodiethyl ether (butyl carbitol thiocyanate), containing 75 per cent. by volume of the thiocyanate and 25 per cent. kerosene, with 3 or 5 per cent. petroleum oil, to which it was added before emulsifying, and two proprietary preparations of dinitro-ortho-cresol, diluted to contain, respectively, 0·1 per cent. dinitro-cresol and 5·0 per cent. petroleum

oil with a protein emulsifier, and 0·1 per cent. sodium dinitro-cresylate with a small quantity of a spreader.

The following is based on the authors' summary : The dinitro-cresol sprays cannot be applied to apples later than the very early green flower stage without risk of serious injury. When applied to black currants immediately after the tight cluster stage and to gooseberries when the flower buds were exposed, they caused complete loss of crop, but red currants treated when the flower buds were opening were undamaged. The applications were made on apple on 25th March, when Aphids, principally *Aphis pomi*, DeG., had just hatched and larvae of *Operophtera* (*Cheimatobia*) *brumata*, L., were hatching, and all the sprays were ineffective against both. The sprays containing 3·0 per cent. or more of petroleum oil provided an appreciable control of the eggs of *Paratetranychus pilosus*, C. & F. (*Oligonychus ulmi*, auct.).

The sprays of dinitro-cresol with oil and the thiocyanate with 3 per cent. oil gave a high degree of control of the eggs of *Anuraphis padi* on plum, to which they were applied on 9th February, immediately before bud burst, and complete control was given by a tar-distillate emulsion (grade A anthracene oil emulsified with a 15 per cent. solution of sulphite lye to a stock emulsion containing 60 per cent. oil), which was applied on 8th–9th February at a concentration of 3 per cent. actual oil. None of the sprays caused any injury to the buds.

Kearns (H. G. G.) & Umpleby (E.). **Experiments on the Control of Pests of Apple Nursery Stock by Means of Dipping. Woolly Aphid and Red Spider. Progress Report No. 1.**—*Rep. agric. hort. Res. Sta. Bristol 1938* pp. 72–77, 1 pl., 4 refs. Bristol [1939].

As cider and culinary varieties of apple planted in farm orchards in western England seldom receive regular insecticidal treatment, considerable damage may be caused during the first 5–7 years of the life of the trees, particularly on cider varieties on crab stock, by *Eriosoma lanigerum*, Hsm. Of recent years, *Paratetranychus pilosus*, C. & F. (*Oligonychus ulmi*, auct.) is also often prevalent on the nursery stock, and it is therefore desirable to treat it for the control of these two pests and also of other Aphids and *Psylla mali*, Schm., before it is planted out. Preliminary experiments indicated that adequate and safe control of *E. lanigerum* can be obtained by dipping nursery trees in a tar-distillate emulsion containing 9 per cent. oil [*R.A.E.*, A **24** 687] and that the success of this measure depends more on the thorough washing of the roots before treatment than on the use of high concentrations of tar oil. Since it was still considered possible that the removal of soil from the roots in conjunction with complete immersion might kill many of the trees, large-scale field trials were conducted during the winter of 1937–38 to confirm the previous findings.

The emulsion employed contained Grade A tar oil (30 per cent. by volume), Grade E petroleum oil (30 per cent.) and a 15 per cent. solution of sulphite lye (40 per cent.) and was diluted to a concentration of 3 per cent. tar distillate, which is effective against *E. lanigerum* and the eggs of other Aphids and of *P. mali*, and 3 per cent. petroleum oil, which, in laboratory experiments, controlled *Paratetranychus pilosus* and facilitated the penetration of the covering of *E. lanigerum*. The combined concentration of the two oils was sufficient to control the eggs of the winter moth *Operophtera* (*Cheimatobia*) *brumata*, L.

Over 1,400 nursery trees of several varieties, most of which supported colonies of *E. lanigerum* and numerous eggs of *P. pilosus*, were treated between 10th and 26th November 1937. The soil was washed from the roots by means of a hose, the emulsion was applied directly to obvious colonies of *E. lanigerum*, and the trees were then completely immersed in a tank (12×3×3 ft.) filled with the emulsion to a depth of 2 ft. After a few moments, they were extracted by means of rubber-covered steel hooks on handles and re-immersed for about 2 minutes, as this process tended to break the air films over wound calluses and facilitate the penetration of the emulsion. No damage resulted from immersion for as long as 30 minutes. The trees were then stacked vertically to dry off. They were planted in permanent quarters in Devon either within a few days of treatment or between early December and mid-February. In May 1938, 99·8 per cent. of the trees were in good condition. The percentages on which *E. lanigerum* and *P. pilosus* were found were 10·0 and 74·7, respectively; infestation by *P. pilosus* was very slight on 44·9 per cent. The degree of control of the mite was of the same order as that obtained in laboratory experiments (94 per cent.) and was insufficient for trees that bore large numbers of eggs. A source of reinfestation by *E. lanigerum* was provided by Aphids sheltering between callus growths over wounds, where the emulsion penetrated only with difficulty. The only other pests observed on the trees were larvae of winter moths, principally the March moth [*Alsophila aescularia*, Schiff.], which attacked most of them, but their presence was due to the trees having become infested after they were planted out and not to the eggs having survived the treatment. Laboratory tests indicated that control of *P. pilosus* was not appreciably increased by greater concentrations of petroleum oil, but a concentration of 5 per cent. would ensure control of Capsids and does not injure the trees.

The emulsion remained stable for over four months in the tank, in which it was protected from dilution by rain but not from frost. During this period, 2,000 trees were dipped in it, and the only precaution necessary was to agitate it before use.

MARTIN (H.). **Accident Prevention in the Use of Poisonous Spray Materials.**—*Rep. agric. hort. Res. Sta. Bristol. 1938* pp. 145–153. Bristol [1939].

The following is substantially the author's summary: The extensive use of pest control materials poisonous or hazardous to man has aroused the apprehensions of Public Health authorities. The grower can do much to prevent accidents and to allay public anxiety. The various methods of accident prevention are reviewed, and the precautions legally enforced or voluntarily observed in different countries are compared. Attention is especially directed to legislative measures affecting growers in Great Britain.

GOUGH (H. C.). **Factors affecting the Resistance of the Flour Beetle, *Tribolium confusum*, Duv., to Hydrogen Cyanide.**—*Ann. appl. Biol.* **26** no. 3 pp. 533–571, 10 figs., 2 pls., 34 refs. London, 1939.

The following is the author's summary: Two types of apparatus for exposing insects to known concentrations of toxic gases, under

controlled conditions, were constructed and are described. The relative resistance of different stages of the flour beetle, *Tribolium confusum*, Duv., to hydrogen cyanide was determined, the results being treated by Bliss's method [*R.A.E.*, A **23** 493, 497]. The order of resistance was pupa (most resistant), adult, larva, egg. The difference in resistance at different ages was found for the pupa, adult and egg. The application to all these results of Cotton's theory of the relation of rate of metabolism and susceptibility to fumigants [**20** 696] is discussed. It is considered that this theory might hold for stages other than the egg.

A series of experiments was carried out to discover whether individual resistance to hydrogen cyanide was inherited. It was found that the offspring of resistant individuals were significantly more resistant than the offspring of susceptible individuals, and that this difference was maintained over several generations. A considerable increase in resistance was found to occur if adult beetles were removed from their flour about an hour, instead of immediately, prior to their fumigation. The reason for this increase was not determined, but various suggestions to account for it are discussed. It was noted that under certain conditions, adult beetles emitted a volatile substance which was self-toxic, and also appeared to react with cyanide. The dosage-mortality curves for all the experiments are discussed and possible reasons for their apparent abnormality put forward.

The experiments here described, which must only be regarded as preliminary, emphasise the complexity of the problems arising in the study of the resistance of living organisms to toxic substances ; the need for carrying out such experiments under as natural conditions as possible ; and the importance of a careful analysis of factors which affect the resistance of the organism.

Bliss (C. I.). **The Toxicity of Poisons applied jointly.**—*Ann. appl. Biol.* **26** no. 3 pp. 585–615, 14 figs., 13 refs. London, 1939.

The following is taken from the author's summary : A quantitative analysis of the toxicity of poisons applied jointly requires that they be administered at several dosages in mixtures containing fixed proportions of the ingredients. From a study of the dosage-mortality curves [*cf. R.A.E.*, A **23** 493, 497 ; **27** 66] for several such mixtures, preferably in comparison with equivalent curves for the isolated active ingredients, most cases of combined action can be classified into one of three types.

The first type is that in which the constituents act independently and diversely, so that the toxicity of any combination can be predicted from that of the isolated components and from the association of susceptibilities to the two components. The coefficient of association can be measured experimentally and should be constant at all proportions of the ingredients. When it is high, the toxicity of the mixture is reduced. The form of the dosage-mortality curve is examined for several hypothetical mixtures. Whenever the curves for the two constituents were assumed to differ in slope, there was a relatively abrupt bend in the curve for the mixture, the rectilinear segments above and below the break approaching in slope the values for the original constituents. This observation indicates that in homogeneous populations the slope of a dosage-mortality curve is of toxicological significance. Since the same numerical relations would be expected

if a single poison were to have two independent lethal effects within the animal, there is theoretical basis for fitting the linear segments of a dosage-mortality curve separately when a break occurs after transformation to probits and logarithms. This argument is extended to time-mortality experiments to explain the smoothly concave curves characteristic of natural mortality.

The second type of joint action is that in which the constituents act independently but similarly, so that one ingredient can be substituted at a constant ratio for any proportion of a second without altering the toxicity of the mixture. With homogeneous populations, dosage mortality curves for the separate ingredients and for all mixtures should be parallel. Although by hypothesis the susceptibility to one ingredient is completely correlated with that to the other, mixtures in this category are more toxic than in the preceding class where association may vary from 0 to 1. The numerical relations are illustrated by an experiment on the toxicity to the house-fly of solutions containing pyrethrin and rotenone. A mixture with a little less than four equitoxic units of pyrethrin to one of rotenone agreed closely with the definition, but one in which the ingredients were about equally balanced showed a significantly greater toxicity than expected on the hypothesis of independent action, indicating the presence of synergism.

Synergism forms the third type of joint action, characterised by a toxicity greater than that predicted from studies on the isolated constituents. It is the reverse of antagonism, which is not considered directly. Two methods are proposed for the analysis of synergism. The more direct is to relate equitoxic dosages of mixture to its percentage composition in terms of the more active ingredient. When both are in logarithms, the relation is linear over a useful range of compositions. This procedure preserves the original structure of the experiment, can be extended readily to three or more ingredients and leads to a convenient practical result. Theoretically it is less satisfactory than a second method in which for equitoxic dosages of each mixture the content of one ingredient (A) is related to the content of the other (B). The equation which satisfies this relation most completely is $(1+k_1A)B^i=k_2$, where the three constants are computed from the experimental data. When the exponent i is equal to 1, only two constants need be determined and their product, k_1k_2, is proposed as a measure of the intensity of synergism.

The synergism between a nitro-phenol and petroleum oil is computed by both methods. The full procedure is also applied to the constituents of seven samples of derris root. The problem of measuring synergism in fumigants is briefly discussed.

THOMPSON (W. R.). **Biological Control and the Theories of the Interactions of Populations.**—*Parasitology* **31** no. 3 pp. 299-388, 6 pp. refs. London, 1939.

In his introduction to this paper on the application of mathematical methods to the study of economic entomology, the author points out that although in work on living organisms, carried out under experimental conditions, mathematical methods have given very valuable results, which can sometimes be usefully related to conditions in the field, and although, within certain limits, such methods are also applicable to natural situations and make it possible to discover the

quantitative laws implied in numerical data and to estimate the significance of differences in samples, the mathematical theories that have been evolved have not the significance attributed to them by some workers and none of them can be considered an adequate representation of events in nature. The second part of the paper consists in a survey of the history of the application of mathematics to the study of insect populations. The third deals with general theories of natural control and the fourth with the hypothesis that organisms search at random for the things necessary for their existence. The fifth contains a summary of the principal mathematical formulations constructed up to the present time. The author concludes that mathematical theories of populations make clear how one quantity varies in function of others under certain definite conditions and may suggest, and have already suggested, experimental investigations and field studies from which very valuable information is derived, but they do not and cannot provide rules for practical operations, for which observation and experiment in nature remain the only safe basis.

Howe (R.). **Note on** *Anthrenocerus australis* **Hope (Col., Dermestidae).** —*Ent. mon. Mag.* **75** no. 903 p. 187. London, 1939.

It is stated in this note that cultures of a Dermestid, larvae of which were taken in 1933 from hides at a wharf in London, have since been maintained on fish-meal and flannel. Adults obtained in 1939 were identified as *Anthrenocerus australis*, Hope [*cf. R.A.E.*, A **24** 753, 754].

Miles (H. W.). **On the Biology and Habits of British Sawflies.**— *Trans. Lincs. Nat. Un.* 1938 pp. 198–206, 8 pls., 14 refs. Louth, 1939.

This brief survey of the bionomics and larval characters of various sawflies occurring in Lincolnshire is intended to show the great variety of habits, life-histories and food-plants found among Tenthredinids. It is emphasised that some species are subject to periods of outbreaks and great scarcity. Thus, the large larch sawfly, *Pristiphora erichsoni*, Htg., was a serious pest in the Lake District in 1907–12, but after a few years it was completely controlled by birds, voles and insect parasites; and *Athalia rosae*, L., was exceedingly common and injurious in turnip fields in East Anglia, particularly along the coastal region, from 1780 to 1880, but has been very rare in Britain during the last 25 years. A study of the fluctuations in numbers of local species and observations on their natural enemies would, therefore, be of great value.

Roebuck (A.). **Notes on the economic Zoology of Lincolnshire during 1938.**—*Trans. Lincs. Nat. Un.* 1938 pp. 216–218. Louth, 1939.

In 1938, considerable damage to wheat in Lincolnshire was caused by *Hylemia* (*Leptohylemia*) *coarctata*, Fall., and local injury by *Apamea* (*Hadena*) *basilinea*, F., the larvae of which attacked the ears, and by *Helophorus nubilus*, F. [*cf. R.A.E.*, A **24** 794]. The leaves of sugar-beet were infested by the larvae of *Ceramica* (*Hadena*) *pisi*, L., which was widely distributed, and *Melanchra persicariae*, L., and particularly by *Aphis rumicis*, L., which was very injurious in July and also attacked beans and even peas; and the roots were

damaged by larvae of *Melolontha* and ground beetles, of which *Pterostichus madidus*, F., *P. vulgaris*, L., and *Harpalus rufipes*, DeG. (*Ophonus pubescens*, Mull.) were the most destructive. Apple trees in some localities were attacked by *Chrysoclista* (*Blastodacna*) *atra*, Haw., which has been absent as a pest for several years [but *cf.* A **25** 497]. *Erythroneura alneti*, Dhlb., was very abundant on the leaves of plum, and the Halticid, *Crepidodera aurata*, Marsh., on willows in some localities. Raspberries and strawberries in one district were damaged by *Otiorrhynchus sulcatus*, F. A larval nest of *Hyponomeuta rorellus*, Hb., was found in mid-June on a willow at Haverholme ; this Tineid, which in 1937 defoliated willows over a considerable area in Suffolk, has not previously been recorded so far north. The larvae pupated at the end of June and the adults emerged on 15th July.

Rau (S. Ananda). **Report of the Entomologist.**—*Rep. Tea Dep. U.P.A.S.I. 1937–38* pp. 12–27, 1 fldg table. Madras, 1938. [Recd. 1939.]

A detailed account is given of experiments with insecticides against *Helopeltis* on tea carried out in October–December 1937 on an estate in south Travancore. The sprays tested comprised 2 and 5 per cent. fish-oil soap [*cf. R.A.E.*, A **26** 148], 2 per cent. bar soap, lime-sulphur (1 : 30), and two proprietary products, all of which were toxic to the insects in preliminary trials, but were only partially effective under field conditions, owing to factors such as the great density of the crown of leaves, which made it impossible to wet their lower surfaces, and the inevitable disturbance of the bushes, which caused the adults to fly away. It is considered that spraying is unlikely to be successful in areas of severe infestation unless the technique is considerably improved. Dusting gave definitely better results, the dusts tested being two proprietary powders and mixtures of pyrethrum and lime (1 : 2). Promising results were also obtained in cage trials when pyrethrum was mixed with sulphur (1 : 2), or with lime and sulphur (1 : 1 : 1). However, dusting would be too expensive, especially in the case of pyrethrum, and improvements in the technique are necessary. Up to 10–15 per cent. of nymphs in the fourth and fifth instars were parasitised by unidentified Hymenopterous larvae ; and the Mermithid parasite previously recorded [**24** 39] was again observed.

Outbreaks of *Cydia* (*Laspeyresia*) *leucostoma*, Meyr., occurred on an estate in Nilgiri-Wynaad and at the experiment station. Eggs of this Tortricid were observed for the first time in the field, and it was found that they were laid on either surface of older leaves, usually the hard and leathery ones, and not on the leaves of the flush, as was believed by previous workers. They would not, therefore, be removed in the normal process of plucking. Usually, a single egg occurred on a leaf, though sometimes two and occasionally three were found. The young larvae were very active and bored into the unopened buds, where they lodged within the marginal roll. The moths were active during the evening, and males and females were almost equal in numbers. A systematic hand-picking of infested shoots to destroy the larvae appears to be the only possible means of control.

Observations on *Gracilaria theivora*, Wlsm., which frequently occurs together with *C. leucostoma*, showed that the eggs are laid singly on the lower surface of the first and second leaves of the flush, the first

being preferred. During severe infestations, however, the eggs may also be laid on the buds and the tender stalk between the leaves, and up to four may occur on a single leaf. The larva bores through the base of the egg into the leaf tissue between the upper and lower epidermis, but after a few days comes to the exterior and rolls the leaves ; it lives and feeds inside the roll, and pupates in a silken cocoon on the lower surface of a leaf. The pupal stage lasts 12–13 days. The adults fly at night. The eggs are removed in the course of plucking, and it is estimated that it is possible to eliminate 70–75 per cent. of them by plucking two leaves and a bud. Removing the rolled leaves, which scarcely affects the growing shoot, should provide an additional measure of control. The parasites observed included *Asympiesella india*, Gir., *Angitia* (*Dioctes*) sp., and *Tetrastichus* sp.

Coccids, sheltered by the nest of an ant and tentatively identified as *Saissetia* (*Lecanium*) *formicarii*, Green, were reported as attacking tea in Nilgiri-Wynaad, this being the first time that this species has been recorded on tea in South India.

Pests of shade trees attracted little attention. *Grevillea* in a nursery in Wynaad was injured by cockchafer larvae, which attacked the roots, and in the Anamallais by various Scolytids. The latter are considered unlikely to survive in healthy trees, owing to the flow of gum. The only pest of *Albizzia* during the year was a Pierid of the genus *Terias* in Central Travancore [*cf.* **24** 41]. Larvae recorded as feeding on *Albizzia* in 1935–36 were identified as the Tineid, *Ascalenia liparophanes*, Meyr.

Rau (S. Ananda). **Report of the Entomologist.**—*Rep. Tea Dep. U.P.A.S.I. 1938–39* pp. 20–27. Madras, 1939.

Enquiries on the status of *Helopeltis* on tea in south India indicate that its distribution has increased and that severe attacks occur in areas that were only lightly affected previously. Termites, of which *Coptotermes ceylonicus*, Hlmgr., and *Calotermes* (*Neotermes*) sp. appear to be the most important in tea bushes, were considerably more active in the Anamallais than in any other tea districts. An unidentified species of *Calotermes* (*Calotermes*) was destructive on an estate in south Travancore, where damage to tea by *Calotermes* has not previously been recorded. The leaf-rollers, *Cydia* (*Laspeyresia*) *leucostoma*, Meyr., and *Gracilaria theivora*, Wlsm., were little in evidence, probably owing to the prolonged drought that occurred during the year. A grasshopper, *Orthacris incongruens*, Carl, caused serious injury on an estate in the Nilgiris, and its egg-masses were found in the soil at the base of the tea bushes. Most of the hoppers were parasitised.

The shot-hole borer, *Xyleborus fornicatus*, Eichh., which had previously been recorded only from central Travancore, was observed on an estate in south Travancore. Other pests of tea included Coccids, of which *Saissetia coffeae*, Wlk. (*Lecanium hemisphaericum*, Targ.) was the most important, and *Zeuzera coffeae*, Nietn., which caused slight injury in the Anamallais and the High Range.

Among pests of shade trees, the Cerambycid, *Xystrocera globosa*, Ol., attacked *Albizzia moluccana* in Peermade, occurring on trees that had cankers on the main stem. It is not known whether the death of a large number of the trees was caused by a disease or the borer ; the latter can probably be controlled by injecting a 10 per cent.

solution of paradichlorobenzene under the bark. An unidentified Membracid was associated with *Xystrocera* on *Albizzia*, making oviposition slits on terminal branches or leaf-bearing shoots. *Gliricidia* in south Travancore was damaged by an unidentified Hepialid, that completely ringed the trees to a depth of about ¼ in. and bored down into the pith to a distance of about 6 ins.

GLOVER (P. M.) & GUPTA (S. N.). **The Practicability of Biological Control in the Lac Industry.**—*Indian J. agric. Sci.* **9** pt. 3 pp. 523–530, 8 refs. Delhi, 1939.

Though the lac insect, *Laccifer lacca*, Kerr, is parasitised by a number of Chalcidoids in India [*R.A.E.*, A **23** 86, 746], they are not of great importance at Namkum (Bihar) where the average rate of parasitism by them during a period of seven years has been only 4·8 per cent. Biological control of these Chalcidoids is not considered possible, since the parasites that attack them also parasitise *L. lacca* [**23** 87]. On the other hand, 30–35 per cent. of the lac cells are destroyed by predators, practically the whole of this damage being caused by larvae of *Eublemma amabilis*, Moore, and *Holcocera pulverea*, Meyr. A list is given of the known or suspected parasites of the larvae and pupae of these two moths [**19** 11 ; **23** 153, 278, 746 ; **25** 635] ; the larval parasites, *Microbracon greeni*, Ashm., which attacks *E. amabilis*, and *M. hebetor*, Say, an imported species that attacks both predators, are the most important [**25** 531].

In view of proposed investigations to determine whether increased control can be obtained by periodic releases of *M. greeni* to supplement the natural population, whether *M. hebetor* can be effectively established at Namkum, and whether either species can be transferred by means of brood lac to other districts, the present status of *M. greeni* in an area where lac similar to that in the experimental area is cultivated is summarised in a table based on records for the years 1928–35 and showing the average numbers of larvae of *E. amabilis* and of adults of *M. greeni* present per 100 ft. of lac during each month of the year, and the percentage parasitism. The average number of adults of *M. greeni* present per month and the average monthly percentage parasitism due to it were 22 and 16·3, respectively, per 100 ft. of lac ; liberations of *M. greeni* are to be made in early August, November and early May, when the natural population is low.

The two Trichogrammatids recently recorded as parasitising the eggs of *E. amabilis*, *H. pulverea* and *Tarucus theophrastus*, F. [**27** 129] have been identified as *Trichogrammatoidea nana*, Zehnt., and *Trichogramma minutum*, Riley.

AHMAD (T.). **Two new Chalcidoid Parasites of the Linseed Midge, *Dasyneura lini* Barnes. I. Biology and Morphology of *Systasis dasyneurae* Mani.**

MANI (M. S.). **II. Description of the Parasites.**—*Indian J. agric. Sci.* **9** pt. 3 pp. 531–539, 1 pl., 9 refs. Delhi, 1939.

In the second part of this paper, descriptions are given of both sexes of the Miscogasterids, *Systasis dasyneurae*, sp. n., and *Ecrizotomorpha taskhiri*, gen. et sp. n. The latter is probably parasitic on the former, which is the Chalcidoid previously recorded as a parasite of *Dasyneura lini*, Barnes, on flax in India [*R.A.E.*, A **26** 242].

The first part of the paper includes descriptions of the immature stages of *S. dasyneurae* and an account of its bionomics, much of the information on which has already been noticed [*loc. cit.*]. The eggs hatched in 24–28 hours in April at field temperatures of 25–29°C. [77–84·2°F.], and eggs collected during the first fortnight of February gave rise to adults in 27–33 days at 15–20°C. [59–68°F.].

At Pusa (Bihar), adults of *D. lini* emerge at the beginning of January [**26** 181] and increase in numbers from the middle of February. They appear rather later at Karnal (Punjab), where, however, eggs of *S. dasyneurae* were abundant from 4th February. Although the parasite develops slowly, it is active early in the season in sufficiently large numbers to enable it to gain an advantage over its host, in the reduction of which it is an important factor. From 3,565 advanced buds of flax collected in the Punjab on 11th February 1937, 254 adults of *D. lini* and 87 of *S. dasyneurae* were reared, and the percentage parasitism of fully-grown larvae was estimated to be as high as 50·7.

CHERIAN (M. C.) & ANANTANARAYANAN (K. P.). **Studies on the Coconut Palm Beetle (*Oryctes rhinoceros* Linn.) in South India.**—*Indian J. agric. Sci.* **9** pt. 3 pp. 541–559, 1 pl., 24 refs. Delhi, 1939.

Studies on the bionomics of *Oryctes rhinoceros*, L., which is the most important pest of coconut palms in South India, were carried out at Coimbatore during 1935–37. The adults bore in living palms and oviposit in moist farmyard manure, or more rarely in decaying vegetable matter such as dead coconut trunks, decomposing coir refuse, heaps of wet sugar-cane trash or compost. The eggs are deposited singly in the manure, 2–6 ins. below the surface of the heap, and the larvae usually occur at depths of 2–12 ins., but during drought, when the dung dries out, the older ones sometimes burrow into the moist soil below the heaps, whereas the young ones die. They migrate from the manure heaps into the surrounding soil some time before pupation, which takes place in an earthern cell 6–12 ins. below the surface, in the sides, or occasionally in the bed, of the pit. In laboratory experiments, full-fed larvae migrated from moist dung to soil when supplied with both ; when only dung was available, many larvae died, but a few continued feeding, and ultimately pupated when the dung had been reduced almost to the consistency of powdery soil. Observations on small numbers of individuals showed that the average durations of the egg and larval stages and the period from the formation of the cocoon until the adult left it varied from 8·88 to 17·36, 99·5 to 182 and 24·6 to 62 days, respectively, in different periods of the year, and that the actual durations of these stages varied considerably in a given period. The larva pupated 10–12 days after forming the cocoon, and the adult left it about 10 days after emergence from the pupa. For individuals reared in the laboratory and in manure pits, the life-cycle lasted 159–232 and 141–192 days.

Females fed on sugar-cane deposited up to 140 eggs in the insectary. Males and females survived for 26–38 and 16–26 days, respectively, without food in the insectary, and for 48–231 and 47–293 days when provided with food under various conditions in the insectary or in field cages. Observations in 1936–37 showed that the beetles are active throughout the year and are especially numerous on trees during March–April, and that the broods overlap.

The damage caused to the coconut palms by the adults is described [*cf. R.A.E.*, A **17** 568] ; the tunnels that they bore in the stems sometimes extend for as much as 2 ft. · Other food-plants include palmyra palm [*Borassus flabellifer*] and talipot palm [*Corypha umbraculifera*], which are less frequently attacked, pineapple, and *Agave*, on which the beetles feed only when palms are scarce.

In experiments on control, baits and light-traps were ineffective, and calcium cyanide inserted into tunnels containing beetles injured the plants. The destruction of the adults and immature stages in trap-pits and breeding material is of some value where it can be practised over a wide area, and the extraction of the adults, by means of a hooked iron rod ($\frac{3}{8}$ in. thick), from their tunnels, which should then be filled with sand, is recommended. There are few natural enemies ; larvae in recently disturbed manure heaps are destroyed by crows, and a mite of the genus *Uropoda* attacks but does not kill the pupae and adults. Overcrowding, lack of moisture or the absence of a suitable site for pupation cause the greatest mortality among larvae and pupae.

A culture of the green muscardine fungus [*Metarrhizium anisopliae*], which attacks the larvae and pupae, was obtained from Ceylon during 1937. In laboratory and field trials, larvae and pupae of *O. rhinoceros* were killed, but eggs were unaffected by the fungus. Adults oviposited in infected dung, but the value of trap-pits inoculated with the fungus [*cf.* **25** 299 ; **26** 434] is limited by the extent to which they oviposit in material other than dung, and by their strong powers of flight. The appearance of symptoms in young infected larvae was delayed, but older ones became discoloured and later covered with mycelium.

ABALOS (R.). **Rice Leafhoppers. 1.** *Nephotettix apicalis* **Motch. 2.** *Nephotettix bipunctatus* **Fabr.**—*Philipp. J. Agric.* **10** no. 2 pp. 205–209, 2 pls. Manila, 1939.

The author briefly describes the adults and full-grown nymphs of *Nephotettix bipunctatus*, F., and *N. apicalis*, Motsch., which he considers a distinct species. These leafhoppers are serious pests of rice in the Philippines, where they are generally abundant during August–October. They attack the plants in all stages of growth, feeding on the leaves and leaf-sheaths, as a result of which the tips of the older leaves dry, yellow spots appear on the mid-ribs and the leaf-sheaths, and the plants become stunted. The eggs are deposited in rows under the epidermis of the leaf-sheaths of young plants and hatch in 5–10 days ; the 5 nymphal instars occupy a total of 13–19 days. Oviposition begins 2–3 days after the emergence of the adults.

Methods of control include weekly applications of a spray of 2 lb. soft laundry soap in 25 gals. water or sweeping with a net or " hopper-dozer." This is made by cutting a petrol tin in half diagonally, attaching a handle to one of the halves, and smearing the inside with adhesive. When the fields are still under water and there are few leaves on the plants, kerosene should be applied to the water and the plants should be struck gently so that the insects fall into it. To avoid damage to the plants, no more kerosene should be applied than is necessary to form a thin film, and the field should be drained, and fresh water admitted, after the leafhoppers have been killed. Adults can be destroyed early in the season, before oviposition begins, by means of light-traps ; one comprising a lantern set in a basin containing

water covered by kerosene, which was carried between the plants while a second person beat them, caught twenty times as many as a stationary trap.

The fields should be weeded thoroughly, and wild grasses, on which the leafhoppers feed and breed, should be destroyed. Poor soil should be manured with a fertiliser containing nitrogen and phosphoric acid, which increases the resistance of the plants.

KONO (H.). **The Relation between Outbreaks of** *Lymantria dispar* **and Sun Spots in Japan.** [*In Japanese.*]—*Bot. & Zool.* **7** no. 8 pp. 1356–1358. Tokyo, 1939.

An outbreak of *Lymantria dispar*, L., occurred in western Hokkaido in 1938, in which year the number of sun spots reached a maximum. The larvae defoliated *Robinia pseudacacia*, larch, wheat, maize and red clover in late June and July, as many as 20 being observed per square foot of soil in some districts. Such outbreaks occur in Japan at intervals of about 11 years, and are apparently limited to the northern extremity of the distribution of the moth when the sun-spot numbers reach a maximum and to the southern extremity of its range when they reach a minimum [*cf. R.A.E.*, A **26** 604].

KATO (S.). **Taxonomic Notes on some** *Hylemyia* **Species (Diptera, Muscidae) injurious to agricultural Plants in Nippon and Manchoukou. 1 & 2.** [*In Japanese.*]—*Bot. & Zool.* **7** nos. 8–9 pp. 1367–1376, 1529–1538, 3 figs. Tokyo, 1939.

Hylemyia floralis, Fall., of which *H. flavopicta*, Mats. [*cf. R.A.E.*, A **26** 770] is a synonym, occurs in Hokkaido, Sakhalin and Manchuria, where it attacks crucifers, especially radish. Crucifers in Hokkaido and Manchuria are also infested by *H. pilipyga*, Villen., which has at least 3 generations a year, the adults emerging earlier than those of *H. floralis*. *H. cilicrura*, Rond. (*platura*, auct.) attacks a wide range of crops in Japan and Manchuria. The adults of these Anthomyiids are described, and keys are given to the adults and larvae.

SHINJI (O.). **On the Trypetidae of north-eastern Japan, with the Description of new Species.** [*In Japanese.*]—*Insect World* **43** no. 10 pp. 288–291. Gifu, Japan, 1939.

The species recorded include *Chaetostomella vibrissata*, Coq., which causes galls on the stems of *Arctium lappa* grown as a vegetable crop in Japan. The larvae hibernate and the adults appear in June.

SONAN (J.). **On the Shot-hole Borer of Tea in Formosa.** [*In Japanese.*] —*Formosan agric. Rev.* **35** no. 10 pp. 795–800, 1 fig. Taihoku, 1939.

Brief descriptions are given of all stages of *Xyleborus fornicatus*, Eichh., and its bionomics are reviewed from the literature. This Scolytid bores in the stems of tea in northern Formosa, where 2–3 generations occur in the year.

PAPERS NOTICED BY TITLE ONLY.

NAKAYAMA (S.). **A List of Granary Insects and their Associates from Japanese Empire.** [*In Japanese.*]—*Ann. agric. Exp. Sta. Govt Tyosen* **10** no. 2 pp. 153–170, 3 pls. Suigen, 1938. (With a Summary in English.) [Recd. 1939.]

HOFFMAN (A.). **Description d'une sous-espèce nouvelle du genre** *Scolytus* **du midi de la France (Col. Scolytidae)** [*S. multistriatus*, Marsh., *therondi*, subsp. n., on elm (*Ulmus campestris*)].—*Misc. ent.* **40** no. 4 pp. 36–37, 1 fig., 1 ref. Castenet-Tolosan, 1939.

HOPPING (R.). **A new Species of** *Ips* [*swainei*, sp. n., from *Picea engelmanni* in Br. Columbia] **(Coleoptera, Scolytidae).**—*Canad. Ent.* **71** no. 8 pp. 168–169, 1 ref. Guelph, 1939.

ESSIG (E. O.). **A new Aphid of the Genus** *Mindarus* [*victoria*, sp. n.] **from White Fir** [*Abies grandis*] **in British Columbia (Homoptera, Aphididae).**—*Pan-Pac. Ent.* **15** no. 3 pp. 105–110, 2 figs., 3 refs. San Francisco, Calif., 1939.

TISSOT (A. N.). **Notes on the Lachnini of Florida with Descriptions of two new Species** [*Cinara newelli* and *C. watsoni* on pines.] **(Homoptera ; Aphiidae).**—*Florida Ent.* **22** no. 3 pp. 33–48, 57 figs. Gainesville, Fla., 1939.

SCOTT (E. I.). **An Account of the developmental Stages of some Aphidophagous Syrphidae (Dipt.) and their Parasites (Hymenopt.).**—*Ann. appl. Biol.* **26** no. 3 pp. 509–532, 6 pls., 13 refs. London, 1939.

BOUNHIOL (J. J.). **Trois insectes qui ont bien mérité de la science : L'élevage en laboratoire de** *Bombyx mori* **L.,** *Lymantria dispar* **L. et** *Galleria mellonella* **L.**—*Rev. Zool. agric.* **37** nos. 2, 3, 5, 6, pp. 17–28, 40–48, 68–80, 81–96, 7 figs., 38 refs. Bordeaux, 1938. [Recd. 1940.]

HEINRICH (C.). **The proper scientific Name for the Corn Ear Worm** [*Heliothis armigera*, Hb.].—*J. econ. Ent.* **32** no. 4 pp. 595–596. Menasha, Wis., 1939.

FLETCHER (T. B.). **New generic Names for Microlepidoptera** [including *Clysiana* for *Clysia*, Hb., preoccupied in Crustacea].—*Ent. Rec.* **52** no. 2 pp. 17–19. London, 1940.

Common Names of Insects approved for general Use by the American Association of Economic Entomologists [supplementary list of 26 names].—*J. econ. Ent.* **32** no. 4 p. 604. Menasha, Wis., 1939. [*Cf. R.A.E.*, A **25** 696.]

ROARK (R. C.). **Review of United States Patents relating to Pest Control** [July–December 1939] **12** nos. 7–12 ; 9, 9, 9, 11, 8, 9 pp. multigraph. [Washington, D.C.] U.S. Dep. Agric. Bur. Ent., 1939.

GUILLAUME (A.) & HERVÉ (G.). **L'appréciation de la valeur insecticide des plantes roténonées, d'après le dosage de la roténone** [methods of estimating rotenone content of *Derris*, etc.].—*Rev. Bot. appl.* **19** no. 216 pp. 552–564, 10 refs. Paris, 1939.

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United States Department of Agriculture (Washington, D.C.) :
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Virginia : 1st Annual Report of the State Inspector for San José Scale, 1896–97 (Richmond, Va., 1897).
4th Report of the State Entomologist and Plant Pathologist (Richmond, Va., 1905).

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Zeitschrift für das Landwirtschaftliche Versuchswesen in Österreich (Vienna) : 21. Jahrg. (1918) Hefte 1–3 & 10–12.

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